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REPORT ON INTERSTATE AIR POLLUTION IN THE SELBYVILLE, DELAWARE - BISHOP, MARYLAND, AREA

Public Health Service
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Air Pollution
Abatement Branch

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INTRODUCTION

Pursuant to a request from the State of Delaware official air pollution control agency, the Secretary of Health, Education, and Welfare, under provisions of Section 5 of the Clean Air Act, Public Law 88-206 (42 U.S.C. 1857-1857g), called a conference to be held November 9, 1965, in Selbyville, Delaware, regarding an interstate air pollution problem in which it is alleged that "an obnoxious and nauseating odor" and " a horrible stench" originating at a plant operated by Bishop Processing Company in Bishop, Maryland, endanger the health or welfare of persons in the Selbyville, Delaware, area (Figure 1).

The Bishop Processing Company plant is located immediately east of the Pennsylvania Railroad line and about 0.2 mile south of Hammon Road in Bishop, Worchester County, Maryland, approximately 4300 feet south of the Delaware-Maryland boundary. Operations of the plant consist of the rendering of chicken offal and feathers, beef bones and fish for the production of high-protein additives used in dog, cat, and poultry feed; bone meal for fertilizer; tallow; and mixed vegetable-animal fats. Population of Bishop, Maryland, according to the 1960 census, was 25 persons.

The Town of Selbyville, Sussex County, Delaware, is approximately 1000 feet north of the Delaware-Maryland boundary on U.S. Highway 113. Population in 1960 was 1,080.

The distance from Bishop Processing Company's plant to the center of Selbyville is about 7500 feet, or slightly less than one and one-half miles.

This report summarizes the activities undertaken, subsequent to receipt of the Delaware request, by the Abatement Branch, Division of Air Pollution, Public Health Service, Department of Health, Education, and Welfare, along the following lines: (1) investigation of odors in the Selbyville-Bishop area, (2) review of available topographical and meteorological information, and (3) inspection of the plant operated by Bishop Processing Company.

THE DRY-RENDERING PROCESS

GENERAL

The dry-rendering process consists, essentially, of cooking animal matter in steam-jacketed vessels to release fats and grease, break down tissue and bone and reduce moisture. End products include tallow, used largely by soap industries; high-protein additives for poultry and animal feed; bone meal, used primarily for fertilizer; and animal or mixed animal-vegetable fats.

Rendering plants perform a very important function, in that they produce useful products from otherwise unsalable animal matter that would present perplexing alternate disposal problems. Obnoxious odors which accompany the process, however, for centuries have relegated rendering plants to the "offensive trades" category, because of their adverse effect on surrounding areas. But technology is such that rendering operations can be and have been modernized, automated and largely deodorized.

THE BISHOP PROCESSING COMPANY PLANT

The Bishop Processing Company authorized personnel of the Abatement Branch to visit the Bishop, Maryland, processing plant for purposes of making engineering evaluations and taking photographs. This voluntary cooperation is gratefully acknowledged.

Depending upon availability of raw material, the Maryland plant of Bishop Processing Company operates up to seven days per week. Usual operations is six days a week and about 12 hours a day. The rendering process starts between 10:00 a.m. and noon, and may continue until late evening. Sometimes operations continue through the night. About 50 people are employed at the plant.

Raw materials consist of chicken offal (entrials, heads and feet), chicken feathers, scrap fish, and beef bones.

Plant processes and odor controls are best explained by tracing the flow of each type raw material through the operation.

a. <u>Bone</u>

Bone is obtained from a soup manufacturer, after it has been used in soup

making. The material is dried in a tube dryer about 50 feet long, which is steam heated and through which air is blown or drawn. The dried product is ground and bagged for sale. It is used primarily for fertilizer.

b. Chicken Offal and Fish

Chicken offal and scrap fish are processed separately, but in the same processing equipment, on the east production line of the plant (Figure 8). Raw material, brought to the plant by open trucks from chicken packing houses or fisheries, is dumped into a receiving pit located outside the north end of the building. The material is raised by screw conveyor to three steam-jacketed, horizontal cylindrical cookers with paddle agitators. Each cooker has four-ton capacity and the batch cooking process, at atmospheric pressure, requires two to three hours.

Vapors from the cookers pass through individual contact condensers, then through a common large water-spray scrubber, before they are vented to the atmosphere.

When a cooking operation is finished, the cooker is opened and the contents spill upon the percolator drain pan; odorous vapors are released into the plant area, which is open to the atmosphere. Tallows are drained into a tank for further processing, and a screw conveyor carries the solid material through a 50-foot long, steam-jacketed tube dryer. Air from the dryer is drawn through the same water scrubber which receives cooker gases. Dried material is put into an expeller (hydraulic press), where additional tallow is extracted, and through a hammermill for grinding before it is packaged for sale.

Tallows from the percolator pan and the expeller are collected in a steam-heated separation tank, where they are heated for several hours. Waste water is drawn off the bottom, and the lighter fats are pumped to finished product storage.

c. Chicken Feathers

Feathers are brought to the plant by open truck from chicken-packing houses and carried by drag conveyer to the west production line (Figure 9), which has three cookers identical to those on the east line. Feathers are cooked at a pressure of 50 pounds per square inch gage for 30 to 40 minutes.

Cooker vapors are passed through individual contact condensers, combined,

then passed through a three-foot cubical, propane-gas fired incinerator for destruction of non-condensible and insoluble odorous materials. Fuel for the incinerator costs about $50 per month.

Upon completion of cooking, the cookers are depressurized and opened, and the contents are dumped into a bin. Vapors are released to the general plant area and the atmosphere. The cooked material is carried by screw conveyor through a 30-foot long tube dryer similar to the one of the east line. Air from the dryer is passed through the same water scrubber used on the east line before venting to the atmosphere. Scrubber water is drained to lagoons.

d. Summary and Discussion

Potential major odor sources in the plant of Bishop Processing Company are:

1. The raw material receiving pit located outside the plant structure and, directly related to this, the condition of raw material, construction and general housekeeping in the receiving area.

2. The water scrubber effluent, which contains non-condensible and water-insoluble odorous gases.

3. Lagoons which receive water from scrubbers.

4. The percolation drain pan area.

5. Effluent from the incinerator.

Other odors may arise from the expeller and tallow-heating operations.

Factors which significantly increase the offensiveness and quantity of odors from rendering plants include: the age and condition of raw material, overcooking, overheating the dryer, excess airflow through the dryer, inadequate control equipment, overtaxing the capacity of condensers and scrubbers, improper disposal and inadequate treatment of liquid wastes, insufficient temperature of residence time in incinerators, poor housekeeping, and failure to collect all emissions for deodorization before release to the atmosphere. Overcoming such deficiencies requires competent engineering evaluation, design and construction; instrumentation sufficient to permit close surveillance of process and odor-control equipment; prompt processing of raw material; and careful attention to cleanliness of the plant and its environs.

METEOROLOGY

EFFECTS OF TERRAIN ON WIND MOVEMENT

The Selbyville-Bishop area is about 40 feet above sea level and flat, with visually imperceptible land slope to the St. Martin River, five miles to the southeast, and to the Atlantic Ocean, ten miles to the east. There is no terrain roughness or abrupt elevation change and there are no tall buildings or structures that significantly affect wind flow. In the absence of convection currents which usually occur in the daytime and are associated with cumulus-type clouds, air pollution, including odors, in the area is carried in a generally straight line from source to receptor.

Selbyville, Delaware, is approximately 7000 feet north of the Bishop Processing Company's rendering plant. Scattered clusters of trees and thick vegetation obscure direct vision between the plant and the town. The trees and vegetation add slightly to surface-friction effects on moving air and somewhat reduce wind speed at low elevations, but they do not affect the general direction of air and pollution flow at ground level. Nor do the trees and vegetation have any significant effect on the directional travel of effluents from the rendering-plant stack, which rises about 50 feet above the surrounding ground; but they are a factor in producing eddies which cause the stack plume to "downwash" to or near ground level, even under relatively stable nighttime atmospheric conditions. The treeless right-of-way of the Pennsylvania Railroad serves as a direct channel for odors from the Bishop Processing Company plant to reach Selbyville when southerly winds are blowing.

WIND DIRECTION AND SPEED

Climatological records covering a period of a year or more are not available in the Selbyville-Bishop area. Therefore, conditions must be estimated from general meteorological knowledge of the East Coast and from observational records of the nearest official meteorological stations at Salisbury, Maryland, and Dover, Delaware.

The annual wind rose for Salisbury, 22 miles south-southwest of Selbyville, is given in Figure 2; and that for Dover, 50 miles to the north-northwest, in Figure 3. Geographical locations for Salisbury, Dover, and Selbyville and the two wind roses are plotted in Figure 4.

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Odors from the Bishop Processing Company clearly reach some portion of the town of Selbyville whenever the wind direction is south-southeast, south or south-southwest. Hence, from the Salisbury and Dover data, it is estimated grossly that Selbyville would be downwind of the rendering plant 12 to 15 percent of the time during a year. When seasonal winds are considered, the town is downwind of the plant more often in summer than in winter.

Some recorded wind data are available from the Aerovane system operated by the Delaware State Air Pollution Authority at the Town Building in Selbyville.

Wind speeds at the Selbyville station for the period from 6:00 a.m. on September 22 through noon on September 23, 1965, during which objectionable odors were detected in Selbyville, are shown in Figure 5. These wind speeds are typical of diurnal variations during summer. During the hours of darkness very light winds, or even calms, are observed. Wind speeds, atmospheric dispersion, and diffusion increase markedly around mid-day.

Figure 6 is a reproduction of segments of the Aerovane record of wind direction during the day and night of the same period shown in Figure 5. Wind direction fluctuations during the afternoon portion of the chart are indicative of atmospheric instability and eddies that cause mixing and dilution; lack of wind direction fluctuations is notable in the early morning segment of the chart.

A one-month wind rose, for the period August 10 through September 10, 1965, at the Selbyville station is plotted in Figure 7. Winds during this period were such that Selbyville was downwind of the rendering plant 17.8 percent of the time. Predominant southerly winds are typical in warmer months of the year.

CALMS

Of significance when considering the rendering plant odor problem is the frequency of calm winds. The annual wind rose for Salisbury, Maryland, (Figure 2) shows 17 percent calms and the one-month record in Selbyville (Figure 7) shows 20.8 percent.

An offensive smell generally becomes stronger in summer after sunset. With rising temperatures during the day, the odor-laden air warms and expands, is reduced in density and rises to a higher elevation until equilibrium is reached with the surrounding atmosphere. The warmer the air, the greater the weight of water it can support.

After sunset the air cools rapidly and contracts; it becomes denser and descends, bringing toward the ground any odorous material which rose with the air during the day. Hence, at night a high concentration of pollution exists at low levels. The cooled air, however, can carry less water and the surplus moisture, with its condensed and absorbed odors, "falls out." Concurrently, the decreased air temperature reduces vertical convection currents, and gases remain stationary at or near ground level.

On a sultry day with light wind, pollution would not be significantly dispersed; within a few hours after sundown, the odorous material which accumulates and ascends with the air during the day will precipitate within a relatively small area in the vicinity of the source. The result is an offensively smelly dew which readily absorbs on skin, clothing, fabrics, furnishings, trees, vegetation, houses, and other porous surfaces, where it remains until washed away or re-evaporated and dissipated. Hence, as complained of in the Selbyville-Bishop area, there is localized and persistent offensiveness even after the Bishop Processing Company has ceased operations. No estimate of the frequency of occurrence of this phenomenon is available, but it is certain that the presence of offensive odor is greater than indicated by wind direction information alone.

ODOR SURVEYS

On three different occasions, the Selbyville-Bishop area was under surveillance for odors by personnel of the Abatement Branch; these periods were August 18 through 23, September 9, and September 22 through 23, 1965.

METHODOLOGY

Using the equipment and methods described in "Objective Odor Pollution Control Investigations," as published in the December 1960 Journal of the Air Pollution Control Association, observers made patrols throughout the area to establish: the presence, types, frequency, and intensity of odors; the sources of odors; and the areas affected by odors during the observations.

Each patrol consisted of traveling by automobile over the streets, roads and highways of the Selbyville-Bishop area (Figure 1). When an odor was detected, the time and location were recorded, odor intensity was measured, wind direction was determined and the extent or spread of the odor was approximated on maps of the area.

Odor strength was measured by means of a Scentometer, which is an instrument of the vapor-dilution type. It uses the human olfactory sense as its detector and the respiratory system as its source of power. Basically, it functions as a gas mask, except that varying amounts of odor-laden air may be by-passed around the odor-absorbing purifying systems to determine the relative strength of an odor.

In the Scentometer, all of the air can be purified, i.e., the odor removed, before it is inhaled by the operator, or by means of critical orifices of specific sizes, four different fractions of odorous ambient air may be mixed with purified air. Thus, the instrument can be used to grade an odor into one of five different strength ranges: A #4 odor is one which still is recognizable after having been diluted about 100-fold with purified air, a #3 odor is one which is recognizable after dilution with about 30 parts of purified air, a #2 odor is one which is recognizable after a dilution of about eight to one, a #1 odor is one which is recognizable after dilution with equal parts of purified air, and a #0 odor cannot be detected after one-to-one dilution in the Scentometer. Experience with the instrument has demonstrated that a #2 odor, irrespective of its quality, will cause

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complaints; #3 and #4 odors are considered serious nuisances, particularly when they are frequent or persistent.

Odors travel with movement of air, and wind-direction observation in an area where odors are detected will indicate the general upwind direction of the source which is emitting the odors. Repetition of this process under various conditions of wind direction will provide sufficient information for precise location of the source through the method of triangulation.

Wind direction in an odorous area was determined by inflating a small rubber balloon with sufficient helium gas to permit the balloon to rise slowly and travel at a low elevation with the prevailing wind. The balloon's path of travel was determined with a hand-held compass. The "North" mark on the compass was pointed at the balloon, and the degree number at the south end of the compass needle was recorded; this compass reading, when subtracted from 360, gave the wind direction in degrees. Horizontal directional movements of the balloon, particularly during variable or unstable winds, required that the angular variance from the prevailing wind direction also be estimated; hence, readings were recorded as wind direction plus or minus the variance as, for example, 90 degrees plus or minus 10 degrees. Supporting and confirmatory meteorological data were available from a recording Aerovane system at the Selbyville Town Building.

The direction of the upwind odor source was indicated by plotting on a map the wind directional lines through the odorous areas and, through a triangulation method, the directional lines converged upon the odor source.

ODOR SOURCES

Reconnaissance of the Selbyville-Bishop interstate area revealed the existence of several potential odor sources, in addition to the Bishop Processing Company rendering plant. These were: (1) the water drainage ditch between Selbyville, Delaware, and Bishopville, Maryland; (2) the water drainage ditch one-third mile southeast of the Bishop Processing Company's plant; and (3) the packing plant of H & H Poultry Company at Hoosier Street and Railroad Avenue in Selbyville, Delaware.

RENDERING PLANT ODORS

Rendering odors are distinctive, characteristic and easily distinguished by quality, pervasiveness and objectionability from sewage and other malodors found in the Selbyville-Bishop area and many other communities.

Table 1 summarizes the results of patrols made to investigate rendering plant odors in the Selbyville-Bishop area. Data are limited to the three periods of observation, totaling nine days, in August and September 1965, during which Abatement Branch personnel investigated the presence of rendering-type odors and their source or sources.

In order from left to right, the columns in Table 1 give the following information:

1. Patrol number
2. Date
3. Time, on the 2400-clock system, when wind direction was determined by balloon observation.
4. Initials of the observers' surnames.
5. Farthest upwind location where odor was observed and, usually, the point of strongest odor.
6. Maximum Scentometer-measured strength of the odor at the Column 5 location.
7. Direction and spread of odors from the rendering plant, in degrees of the compass.
8. Wind direction, in degrees, as measured by compass observation of slow-rising balloon.
9. Wind direction, in degrees, averaged over 15 minutes encompassing the time given in Column 3, as measured by the Aerovane Wind Recording System located at the Town Building in Selbyville.
10. Average wind speed, in miles per hour, for the time and using the system in Column 9.

OTHER ODORS

Other potential odor sources, in addition to the Bishop Processing Company plant, were investigated during the three periods of observation by Abatement Branch personnel.

On several patrols in the evening hours, septic odors were noted in the

vicinity of the drainage ditch between Selbyville, Delaware, and Bishopville, Maryland, where it crosses Route 17 and where it crosses the road to Fenwick Island. At 10:15 and 10:20 p.m. on September 9, 1965, at these respective points, this septic odor was measured as #2 on the Scentometer, but it was not detected at distances greater than 200 feet from the drainage ditch. It is probable that this odor results from overflow of individual sewage systems to the drainage ditch in the Town of Selbyville. The septic odor does not approach, in any respect, the offensive and prevasive rendering-type odor.

Also, on several patrols, a rendering-plant type odor was noted around the drainage ditch which crosses Old Stage Road about one-third mile southeast of the Bishop Processing Company's plant. At 10:40 p.m. on September 9, 1965, this odor was observed as #3 on the Scentometer; the odor was not detected more than 50 feet from the ditch. It is likely that this odor is derived from scrubbing water which enters the drainage ditch from lagoons of the Bishop Processing Company.

During this investigation, no significant or measureable odors were found to be emitted from the packing plant of the H & H Poultry Company in Selbyville, Delaware, or from sanitary sewerage facilities within the Town; except in the vicinity of the drainage ditches, objectionable odors never were found other than downwind from the Bishop Processing Company's plant.

RESULTS OF ODOR PATROLS

Compositely depicted in Figure 10 are the results of all patrols. The outlined area shows the extent of rendering-type odors and clearly demonstrates interstate travel of pollution. Areas where localized septic odors from drainage ditches were noted also are shown.

Figures 11, 12 and 13 illustrate the method used to locate the odor source by triangulation. Patrols made at different times and under vastly different wind conditions are combined on each figure. The projected wind-direction lines, obtained from compass observations of balloon flight intersect at or near Bishop Processing Company's plant and indicate it as the source of malodors.

Figures 14 through 31 depict results of each individual patrol during which odors were detected. On each Figure are shown: the locations and times when odors were detected; the intensity of each odor, as determined by Scentometer; and the wind direction and range, determined from either balloon flight or the Aerovane record, plotted from the plant of Bishop Processing Company as a focal point. In

each case, odors were detected downwind in the areas one would have predicted from wind direction information. These results, again, clearly demonstrate that the plant of Bishop Processing Company is the source, and the only source, of offensive rendering-type odors in the Selbyville-Bishop area.

Figures 19 and 21 appear to show that odors were detected outside the influence of the suspected source. It should be noted, however, that winds were exceedingly light or calm during these two patrols (see Table 1), and may have been too light to actuate the anemometer in response to slight shifts of wind. Also, during these patrols, odors could well have pervaded the entire plant vicinity near ground level, due to stable atmospheric conditions and moisture "fall-out" as the air cooled rapidly after sundown.

Patrols #1, 16, and 19 merit special consideration because they demonstrate interstate transport of the odorous air pollutants.

Patrol #1 (Figure 14) - On August 18, 1965, at about 5:50 p.m., a very strong rendering-type odor was smelled on Hammon Road in Maryland, east of the Pennsylvania Railroad crossing and about 500 feet north of the Bishop Processing Company plant. The odor caused the observer to become nauseated, so he left the vicinity immediately. From 6:10 until 7:20 p.m., he patrolled Selbyville, Delaware, during which time the odor persisted all along Church Street from the Pennsylvania Railroad crossing east to Main Street. Odor strength was measured with the Scentometer and found to be #2. Wind direction, as determined from balloon flight, was 172° $\pm$ 5° and the direction from the Bishop Processing Company plant to the area where odors were detected in Selbyville, as determined from aerial photographs, is 178° $\pm$ 8°. At 7:25 p.m., the odor on Hammon Road was measured as #3. No odors were detected south, east or west of the Bishop Processing Company plant.

Patrol #16 (Figure 27) - On September 9, 1965, the observer arrived by automobile in Selbyville, Delaware, at 8:00 p.m. and observed the rendering-type odors were present in nearly all portions of the community from the railroad eastward. The odors persisted until 8:30 p.m., when they moved to the east and were observed briefly about one-half mile west of the drainage ditch on the road to Fenwick Island. At 8:50 p.m., the odor on Church Street in Selbyville was measured as #2 strength on the Scentometer; by 9:30 p.m., it had increased in strength to #3 on Church Street.

At 9:00 p.m., near the intersection of Line Hotel Road and Old Stage Road, the odor was measured as #4 scentometer strength. At 9:15 p.m. a #4 odor, which was

nauseating to the observer, existed on Hammon Road between the railroad and Old Stage Road. At 10:45 p.m. the odor had moved just east of the Selbyville Town limits. Odors on Hammon Road and Old Stage Road at this time still were so strong they caused nausea. The odor was not found to the south, east or west of the Bishop Processing Company plant.

Wind direction was determined by release of two balloons at 8:30 p.m. and found to be 182° ± 10° and 187° ± 5°. The Aerovane wind system recorded directions at 195° ± 25° from 8:23 to 8:37 p.m., and at 192° ± 10° at 8:30. The direction from Bishop Processing Company's plant to the area where odors were observed, as determined from aerial photographs, is 180° ± 10°.

Patrol #19 (Figure 30) - On September 22, 1965, from 8:00 to 8:30 p.m., rendering-type odors were observed in Selbyville, Delaware, between Route 113 and the railroad. At 8:20 p.m., odor strength was measured as #1 on the Scentometer. Similar odors were noted on Hammon Road between Route 113 and Old Stage Road, and on Line Hotel Road between Route 113 and the railroad, but no strength measurements were made. The odor was not detected south, east or west of the Bishop Processing Company's plant. Wind direction as determined by balloon flight was 182° ± 10°, and the Aerovane record for the 15-minute interval was 165° ± 0°. The direction of the Bishop Processing Company plant, as determined from aerial photographs, is 162° ± 8°.

EFFECTS OF ODORS

Of all man's senses, least is known about olfaction. The nose is so sensitive that no instrument of science comes close to matching it in sensitivity or versatility as an odor meter. It can respond to thousands of distinct odor stimuli. It can detect odors in extremely dilute concentrations of gaseous material.

The response to an odor, however, is almost entirely subjective. What is pleasant or fragrant to one person may be unpleasant or malodorous to another. Rendering odors, however, consisting of malodorous sulfides of all types, aldehydes and aliphatic amines, come as close as any odor to be universally displeasing, repulsive, repugnant, and sickening.

Effects of odor on behavior have been given insufficient attention. It is known, however, the physiological processes of any individual with respiratory ailments will be adversely affected, however slightly, by odors and other air pollutants. Thus, the condition of an afflicted person under the influence of odors will be exacerbated to the level of a person with a more advanced respiratory condition. This could result in loss of sleep, general weakness, greater susceptibility to other diseases, irritability, loss of appetite and a loss of work days.

A healthy individual, while he may not be greatly affected by low-level chemical and particulate pollutants, undoubtedly will be affected by noxious odors. While odors may not cause organic disease, they can seriously affect his behavior adversely, on both physiological and psychological bases.

Offensive odors such as have been identified as originating from the Bishop Processing Company's plant generally are recognized as capable of producing nausea, vomiting and headache; curbing appetites, imparing nutrition and curtailing water intake; disturbing sleep; upsetting stomachs; hampering proper physiologic breathing; offending the senses and interfering with comfortable enjoyment of property. Most of all, they mar good dispositions and are provocative of emotional disturbances, mental depression and irritability.

Sociologically, such noxious odors can ruin personal and community pride, interfere with human relations in various ways, discourage capital improvements, lower socio-economic status and damage a community's reputation. Economically,

they can stifle growth and development of a community. Both industry and labor prefer to locate in an area which is a desirable place to live, work, and play; and the natural tendency is to avoid communities with obvious odor problems. Tourists shun polluted areas. The resulting decline in market or rental property values, tax revenues, payrolls and sales can be disastrous to a community.

CONCLUSIONS

1. Wind flow in the Selbyville, Delaware - Bishop, Maryland area is not significantly affected by terrains, trees, structures of other objects .

2. On an annual average, winds blow from the Bishop Processing Company Plant in Bishop, Maryland, to some part of Selbyville, Delaware, 12 to 15 percent of the time; the frequency of winds in this direction is greater in summer than in winter. In addition, during periods of calm, malodors pervade the area.

3. Wind speeds are moderate and the atmosphere generally is unstable with many eddies during the daytime; at night, winds often are very light, or calm, and the atmosphere is stable. These meteorological conditions are consistent with observations that objectionable odors are most frequent, persistent, and strongest during the hours of darkness.

4. During 18 of 20 patrols, and on eight of nine days in August and September 1965 when observations were made by personnel of the Abatement Branch, Division of Air Pollution, Public Health Service, Department of Health, Education, and Welfare, rendering-process odors were detected in the Maryland area around the Bishop Processing Company plant.

5. On one-third of the days during which observations were made, similar rendering-process odors were detected in Selbyville, Delaware.

6. The plant operated by Bishop Processing Company in Bishop, Maryland, is the source of these rendering-process odors.

7. There is interstate transport of rendering-process odors across the State boundry from Maryland to Delaware.

8. The offensive, nauseating, repulsive and repugnant odors discharged, emitted, or released from the plant operated by Bishop Processing Company in Bishop, Maryland, are of such nature, quantity, frequency, persistence and objectionability as to endanger the health and welfare of persons in Selbyville, Delaware, and the pollution is, therefore, subject to abatement under provisions of Section 5 of the Clean Air Act, Public Law 88-206 (42 U.S.C. 1857-1857g).

9. Technology is sufficient to prevent or minimize the escape of odors to the outdoor atmosphere from rendering processes such as those conducted by Bishop Processing Company.

10. It is recognized that the Bishop Processing Company has made efforts to prevent

and control the emission of noxious odors from its operations, but such measures have proved inadequate.

RECOMMENDATIONS

Based on the above conclusions, the Department of Health, Education, and Welfare recommends:

1. That Bishop Processing Company abate the emission, release, or discharge of offensive odors from its rendering plant in Bishop, Maryland, in accordance with the following schedule:

   a. On or before March 1, 1966, the Company submit to the appropriate authorities for review and approval plans, specifications and a program to implement prevention and control of malodorous emissions.

   b. On or before June 1, 1966, the Company submit to the appropriate authorities evidence, such as purchase orders, contracts or other binding commitments, which demonstrate firm intention to construct and install necessary equipment and take all other actions designed to carry out the approved program plan for prevention and control of offensive odors.

   c. On or before September 1, 1966, the Company have in operation and submit to the appropriate authorities a final report on the construction, installation, and effectiveness of measures taken to prevent and control malodorous emissions.

Factors meriting consideration in a planned odor-prevention and -control program include the following:

   a. It is mandatory that competent resources be utilized for comprehensive engineering evaluation, planning, and design of corrective measures.

   b. Condition, storage and processing of raw materials. Uncooked raw materials are very prone to decomposition, and raw feedstocks require careful attention. Incoming materials should be collected and processed as rapidly as possible, preferably within eight hours. All practicable means should be employed to limit decay. If feedstocks are to be held more than 24 hours, refrigeration should be provided. Aside from odors emanating directly from raw material, scientific analyses have shown that processing odor problems are much more

intense when stale, rather than fresh, fish or flesh is cooked.

c. Construction and housekeeping. Stringent sanitation measures will go far toward minimizing rendering-plant odors. Equipment and exposed surfaces must be so designed and constructed of such materials that they can be flushed readily with steam and hot water. Floors, driveways, and receiving areas should be constructed of non-porous materials, sloped to drain and scrupulously cleaned to prevent accumulation of spilled material. Pockets where animal matter can collect and decay should be avoided. Ducted ventilation should be provided over each source of smell, and all odorous air should be deodorized before release to the outdoor atmosphere.

d. In treating odorous gases, the principal consideration is make-up of the odorous stream.

   1. Cooker exhaust products are principally steam, but also included are small quantities (less than five percent) of extremely odorous gases. Contact condensers and scrubbers condense and absorb much of the odorous fraction, but small amounts of non-condensible and insoluble gases remain. Combinations of condensers and incineration devices have been utilized to achieve odor-removal efficiencies greater than 99.99 percent.

   2. Effluents from dryers, although less odorous than those from the rendering process, contain large quantities (about 80 percent) of air and other non-condensible gases. Thus, scrubbers do not affect a great reduction in volume and total incineration should be employed.

e. Process controls and instrumentation. Sufficient instrumentation and auxiliary equipment should be available to permit close control of the following:

   1. Overheating in cookers, which creates additional odorous compounds. Addition of tallows to cooker feed has been used to increase heat transfer and enhance heat uniformity throughout the mixture.

   2. Overheating in dryers, which also can intensify odor problems.

   3. Excess air flow through dryers, which unnecessarily increases the

quantity of odorous air that must be treated.

4. Complete incineration of odors. Partial combustion of odorous gases often is worse than no incineration at all. To assure effective odor control, gases whould be burned in a separate incinerator or in a boiler firebox engineered to provide a minimum temperature of 1200°F for at least 0.3 second. Recording, or at least indicating, temperature sensors and alarms should be provided to alert operating personnel to combustion temperatures which are inadequate for odor destruction.

f. Waste from condensers and scrubbers. Odor-laden water from contact condensers and scrubbers cannot be circulated through cooling towers for re-use, because either the smells will be released directly to the atmosphere through aeration or the cooling-tower wood will absorb the pollution and, after a time, become a source of malodors. Surface condensers, followed by incinerators, often are more satisfactory because the surface-condenser cooling water may be recirculated. It does no good to condense or scrub odors from a vaporous or gaseous state and then discharge the wash water into an open ditch or lagoon that cannot dilute it below an acceptable level. Oxidative treatment of liquid wastes may be employed to prevent escape of odors to the atmosphere.

g. Other odor-control methods. Adsorbents such as activated charcoal are virtually precluded as primary control devices for rendering-plant odors, unless gas temperatures are below 120°F, the stream is relatively free of particulates and the moisture content is extremely low; in some cases, they can be used as secondary control devices. Odor masking agents and counteractants have not been demonstrated to be effective in abating local odor nuisances from rendering plants.

2. That the Maryland State Department of Health monitor activities of and maintain surveillance over all operations of the Bishop Processing Company to assure that adequate corrective measures are taken to abate the odor problem in accordance with the above time schedule.

3. That the Delaware State Department of Health and the town of Selbyville, from the date of this conference, continue to maintain surveillance and compile records regarding interstate travel of malodors from the Bishop Processing Company.

4. That Bishop Processing Company, the Maryland State Department of Health and the Delaware State Department of Health transmit to the Department of Health, Education, and Welfare, at least quarterly, reports of progress, or lack of progress and the reasons therefore, in implementing the above recommendations.

REFERENCES

1. Gruber, C. W., and Jutze, G. A., "Odor Determination Techniques for Air Pollution Control, "Journal of the Air Pollution Control Association, August, 1960.

2. Huey, N. A., Broering, L. C., Jutze, G. A., and Gruber, C. W., "Objective Odor Pollution Control Investigations," Journal of the Air Pollution Control Association, December, 1960.

3. Climatography of the United States, No. 60-7, Weather Bureau, U.S. Department of Commerce.

4. McCord, C. P., and Whitheridge, W. N., Odors: Physiology and Control McGraw-Hill, 1949.

5. Mills, J. L., Walsh, R. T., Luedtke, K. D., and Smith, L. K., "Quantitative Odor Measurement," Journal of the Air Pollution Control Association, October, 1963.

6. Teller, A. J., "Odor Abatement in the Rendering and Allied Industries," Journal of the Air Pollution Control Association, April, 1963.

7. Summer, W., Methods of Air Deodorization, Elsevier Publishing Co., 1963.

8. Control of Stationary Sources, Volume 1, Technical Progress Report, Los Angeles County Air Pollution Control District, April, 1960, "Rendering Equipment," pages 134-136.

Table 1. SURVEY FINDINGS - RENDERING-PLANT ODORS

1 Patrol #	2 Date 1965	3 Time EDST	4 Observer	5 Location	6 Maximum Odor #	7 Direction from plant	8 Balloon wind direction	9 Aerovane wind direction	10 Aerovane wind speed
1	8/18	1908	H	Hammon Rd.	#3	175 ± 15	172 ± 5	None	5
2	8/19	1540	H&W	Old Stage Rd.	#1	275 ± 35	277 ± 5	285 ± 40	6
3	8/19	2145	H&W	Old Stage Rd.	#1	310 ± 10	302 ± 5	310 ± 0	1[d]
4	8/20	0900	H&W	Rt. 113	#2[a]	360 ± 20	337 ± 10	10 ± 45	9
5	8/20	1500	H&W	Rt. 113	#1	50 ± 50	52 ± 10	50 ± 45	6
6	8/20	2028	H&W	Old Stage Rd.	#2	270 ± 20	302 ± 10[b]	Calm	0
7	8/21	1321	H	Rt. 113	#2	125 ± 25	128 ± 10	135 ± 40	5
8	8/21	1945	H	Rt. 113	#0	110 ± 40	142 ± 10	160 ± 0	1[d]
9	8/22	1030	H	Rt. 113	#0	85 ± 40	Rain[c]	110 ± 50	5
10	8/22	1430	H		None		262 ± 10	280 ± 40	2
11	8/22	1945	H		None		292 ± 10	335 ± 15	3
12	8/23	1105	H	Rt. 113	#2	75 ± 50	92 ± 10	80 ± 40	2
13	8/23	1235	W	Rt. 113	#0	65 ± 65	42 ± 5	60 ± 50	2
14	8/23	1505	H	Rt. 113	#0	75 ± 50	32 ± 10[b]	40 ± 35	1[d]
15	8/23	1930	W	Rt. 113	#0	75 ± 50	62 ± 5	80 ± 40	1[d]
16	9/9	2030	H	Hammon Rd.	#4	180 ± 15	187 ± 5	195 ± 25	4
17	9/22	1035	W	Old Stage Rd.	#1	210 ± 30	202 ± 5	215 ± 55	7
18	9/22	1415	W	Old Stage Rd.	#0	190 ± 10	192 ± 10	215 ± 55	10
19	9/22	2005	W	Hammon Rd.	e	175 ± 25	182 ± 10	165 ± 0	2
20	9/23	1000	W	Old Stage Rd.	#0	210 ± 30	212 ± 10	215 ± 45	6

[a]Observer W detected #1 odor

[b]No wind below 30 feet.

[c]Balloon would not rise.

[d]Estimated value.

[e]Not measured.

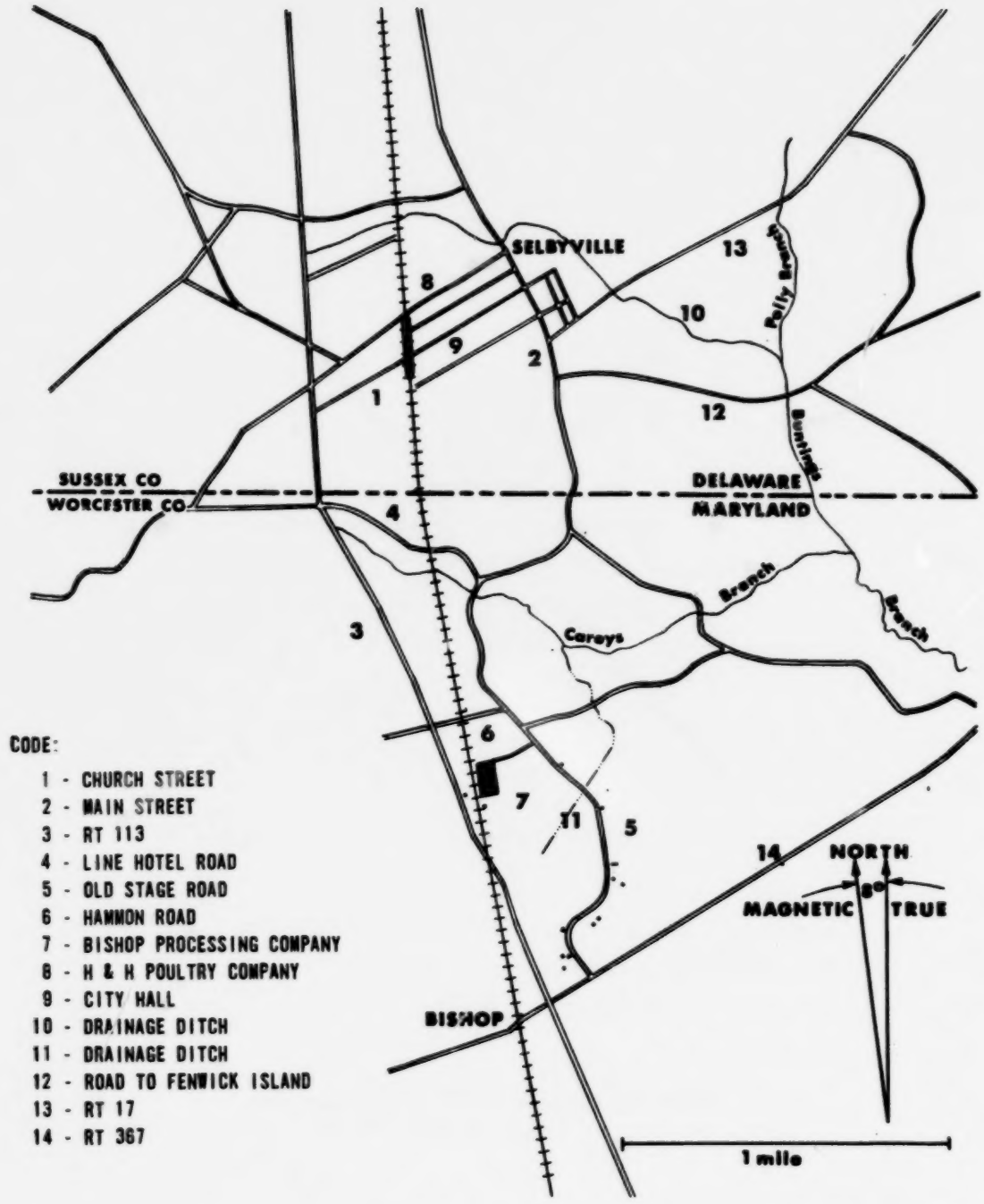


Figure 1. Odor survey area

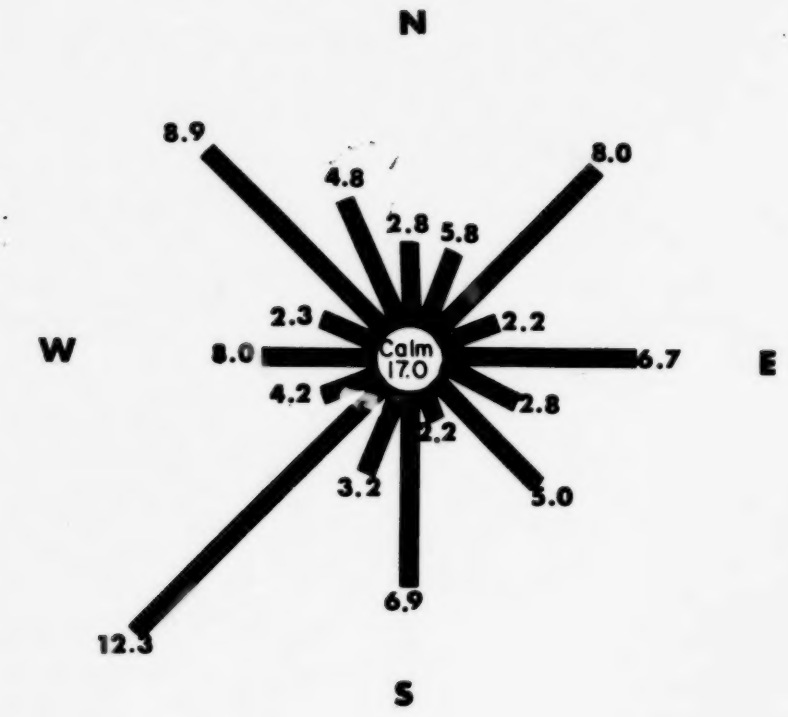
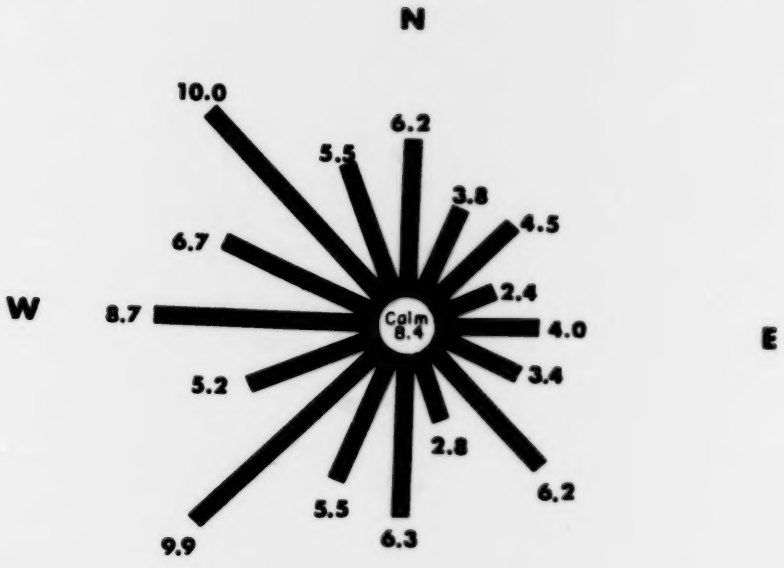


Figure 2. Annual wind rose for Salisbury, Maryland.



Period of Record

Dec 1942 - Sep 1946
Jul - Sep 1949
Sep 1950 - Aug 1956

Air Weather Service
Asheville, N.C.

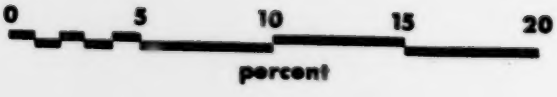


Figure 3. Annual wind rose for Dover, Delaware.

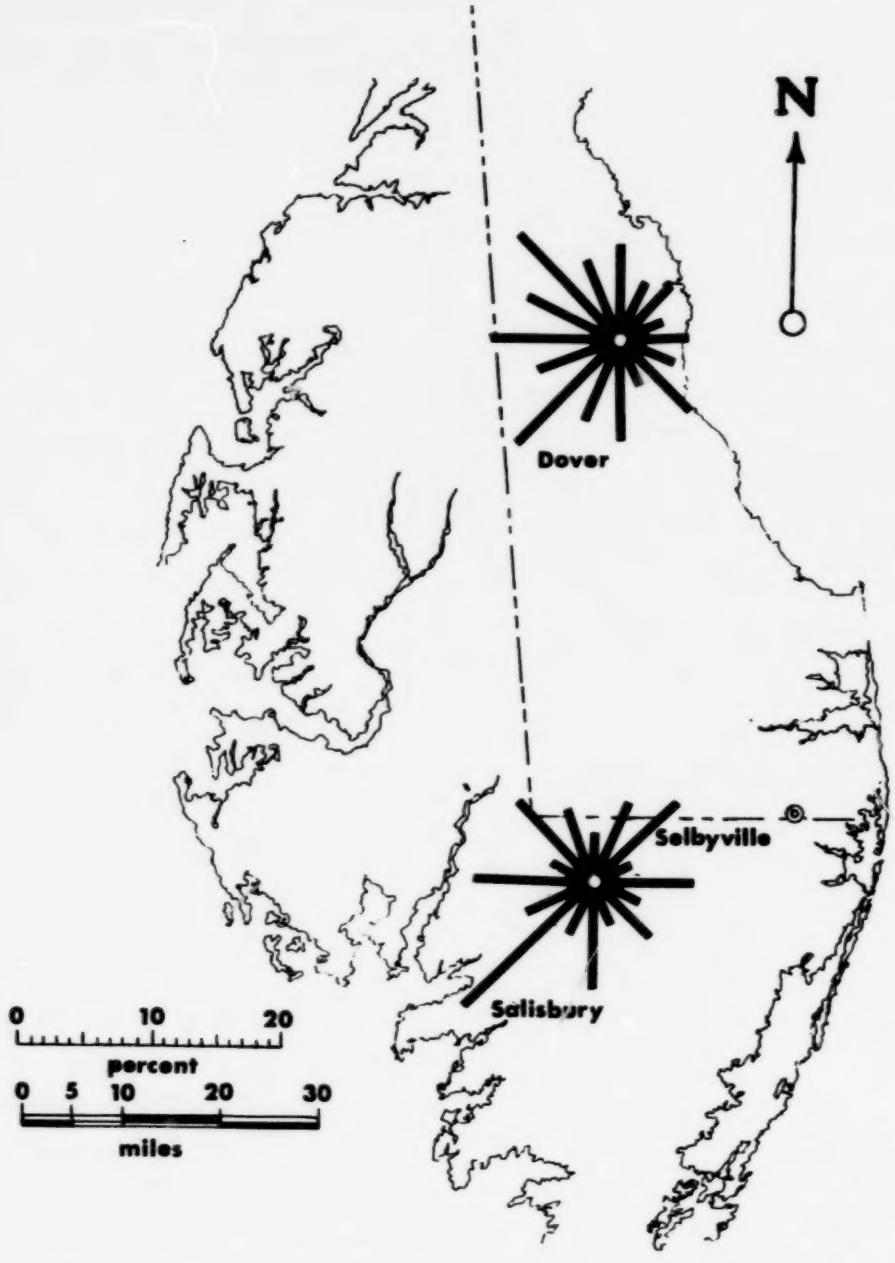


Figure 4. Annual wind roses for Dover, Delaware, and Salisbury, Maryland.

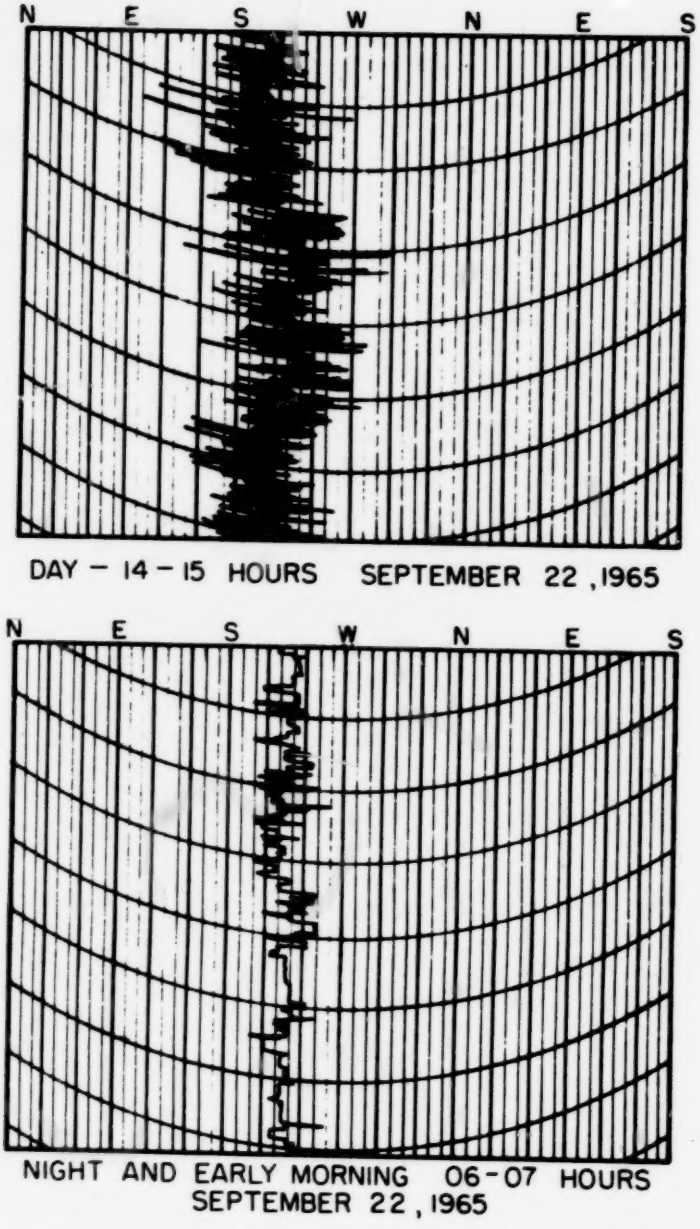


Figure 5. Examples of wind direction records for Selbyville, Delaware.

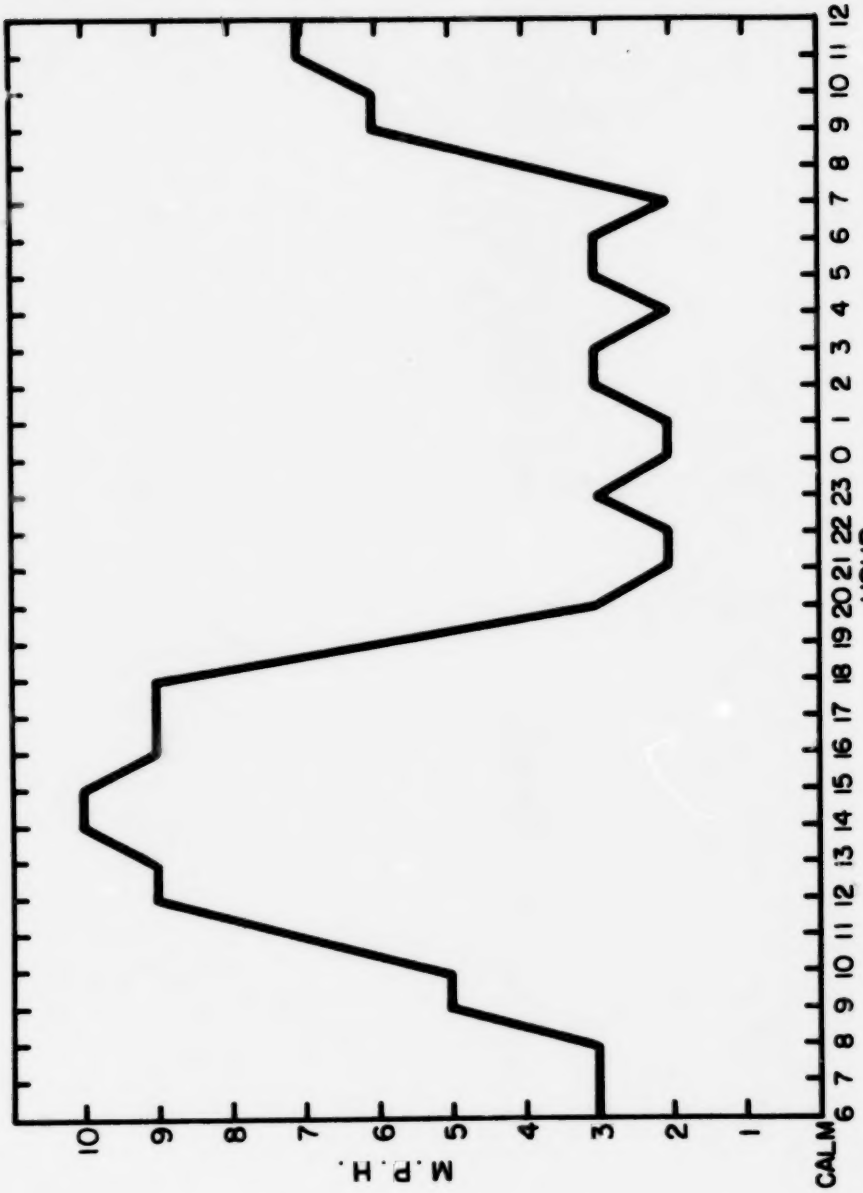


Figure 6. Wind speed record September 22-23, 1955, for Selbyville, Delaware.

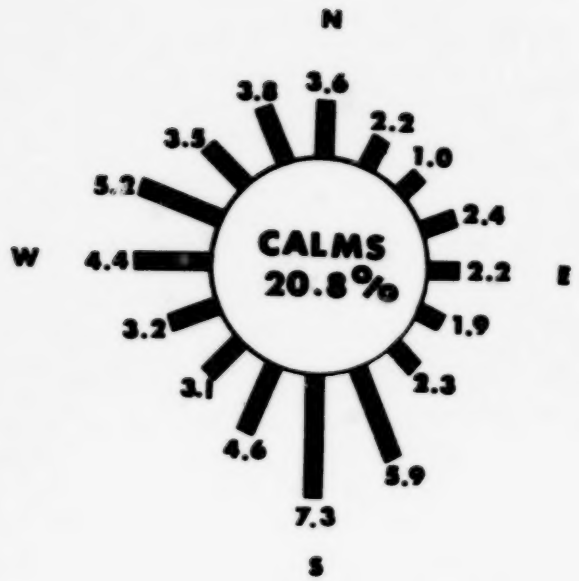


Figure 7. Wind rose for the period August 10 to September 10, 1965 for Selbyville, Delaware (Note: No data for 21.6% of the period).

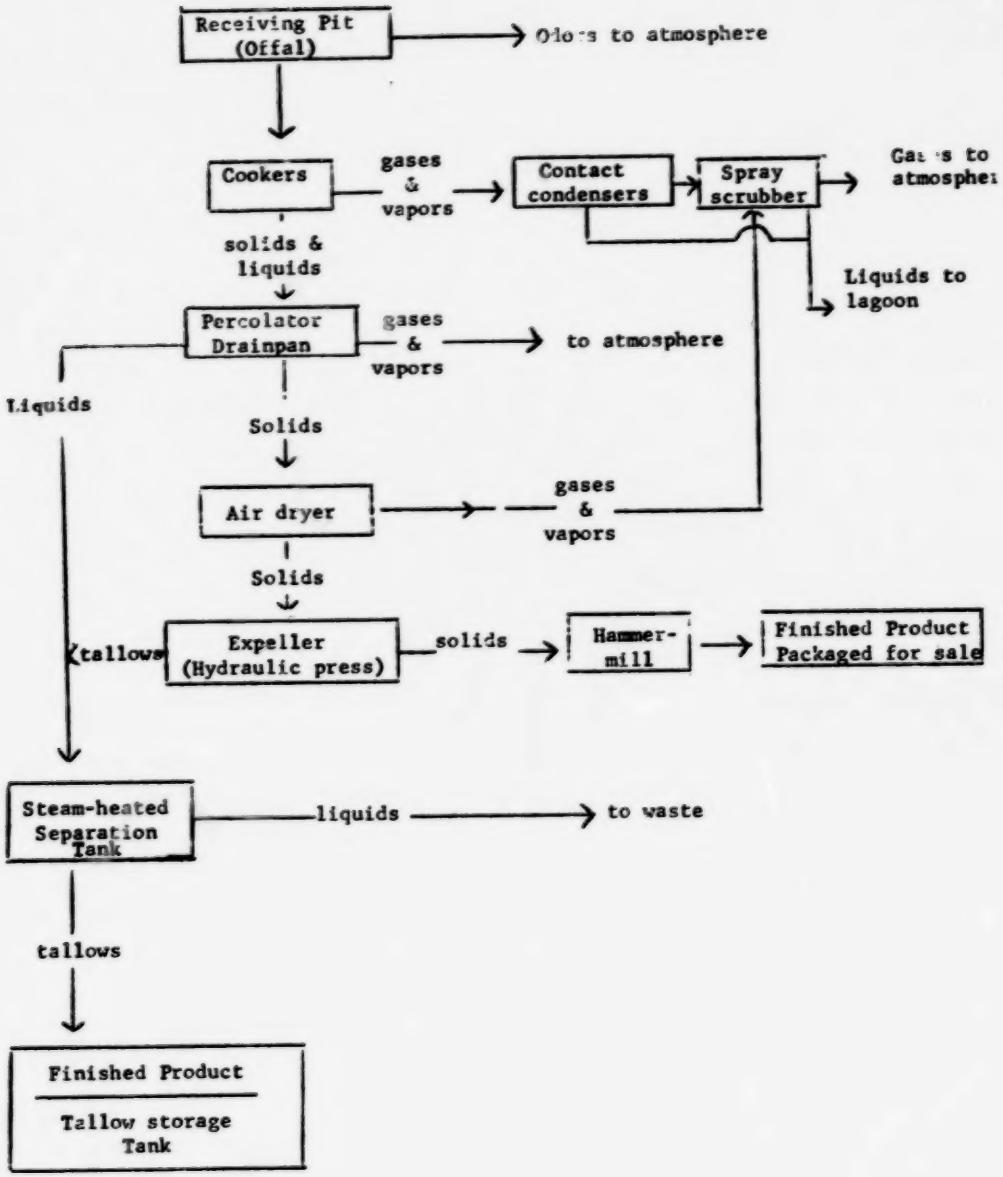


Figure 8. East Production Line, Bishop Processing Company

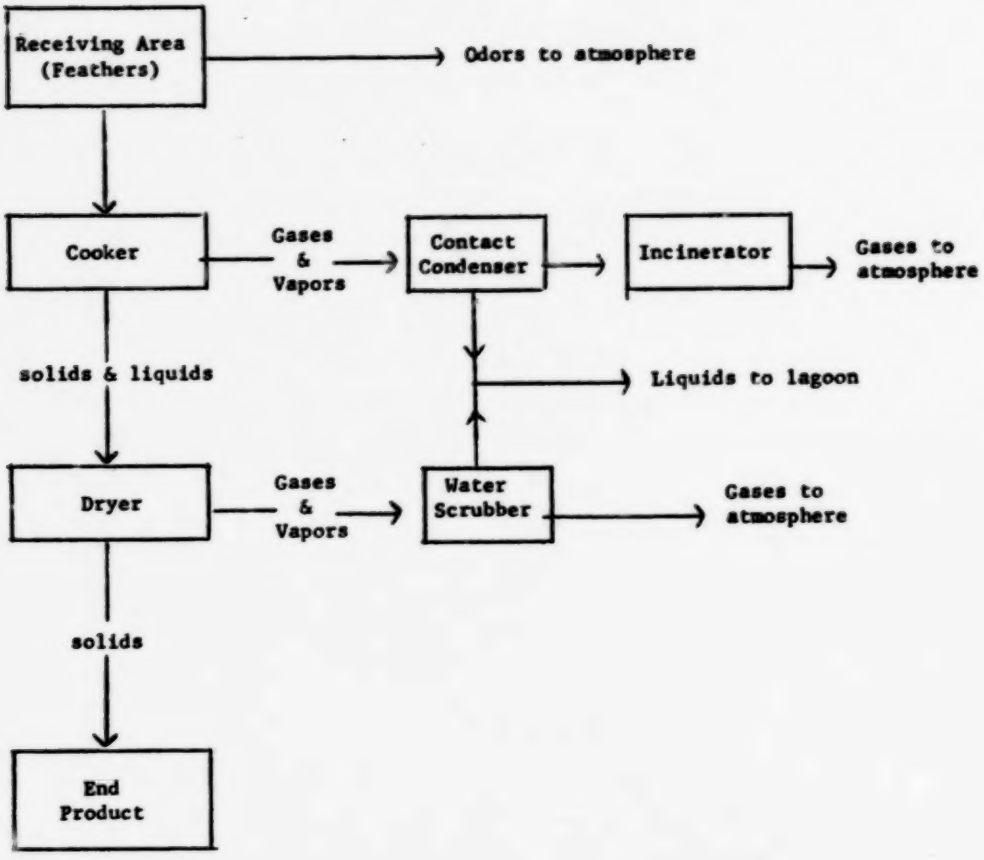


Figure 9. West Production Line, Bishop Processing Company

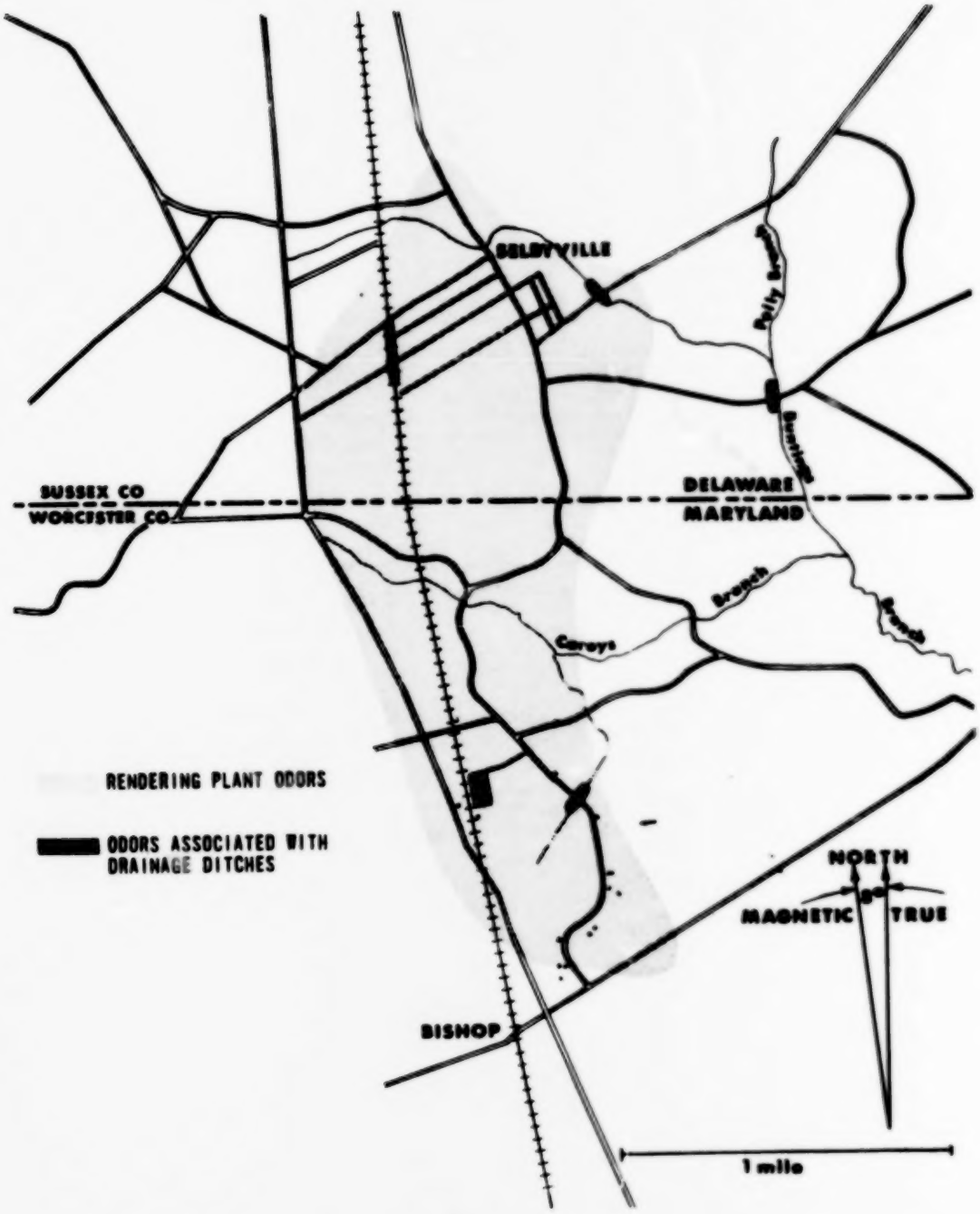


Figure 10. Observed location of odors during surveillance periods.

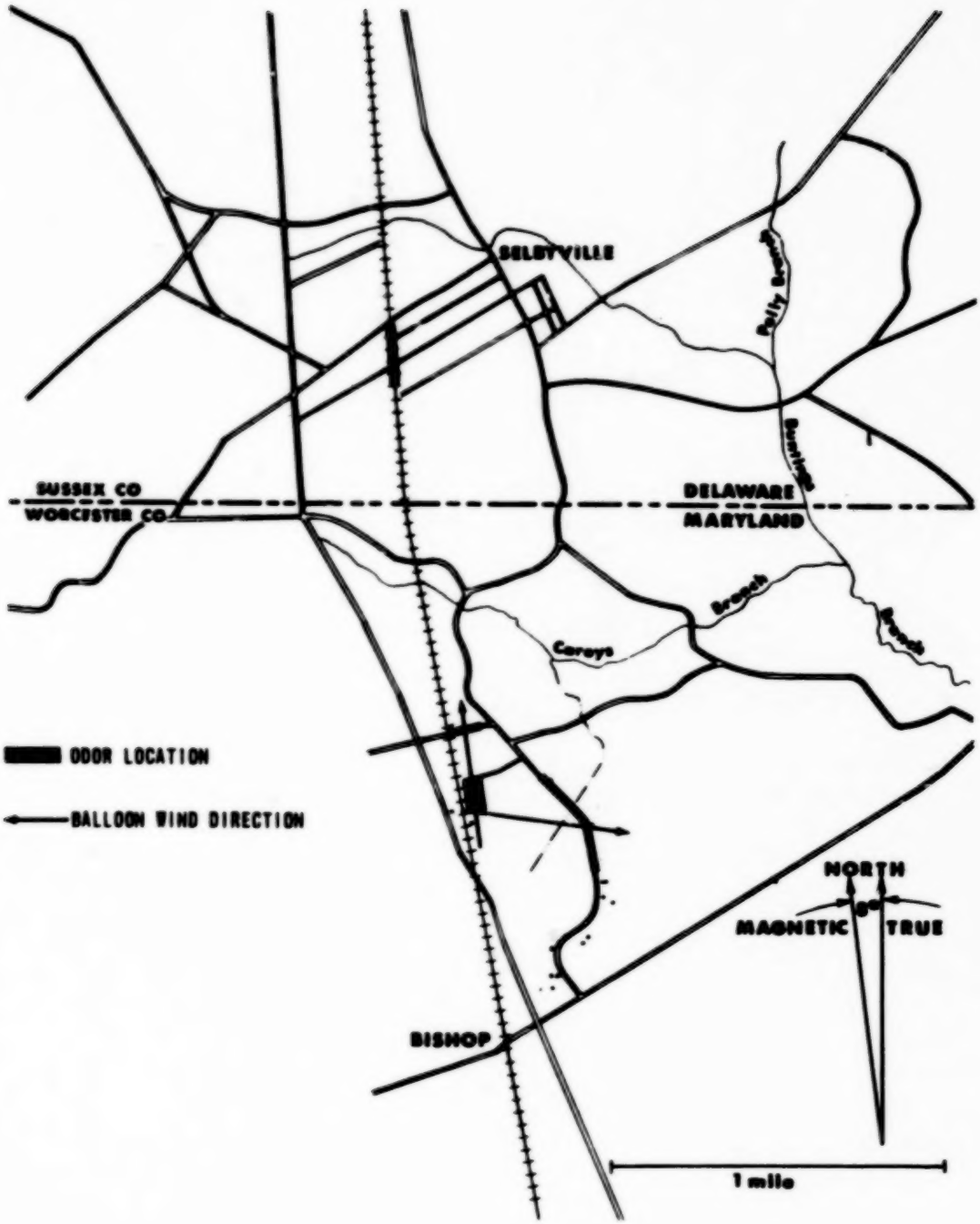


Figure 11. Source location by triangulation with data from Patrols No. 1 and 2.

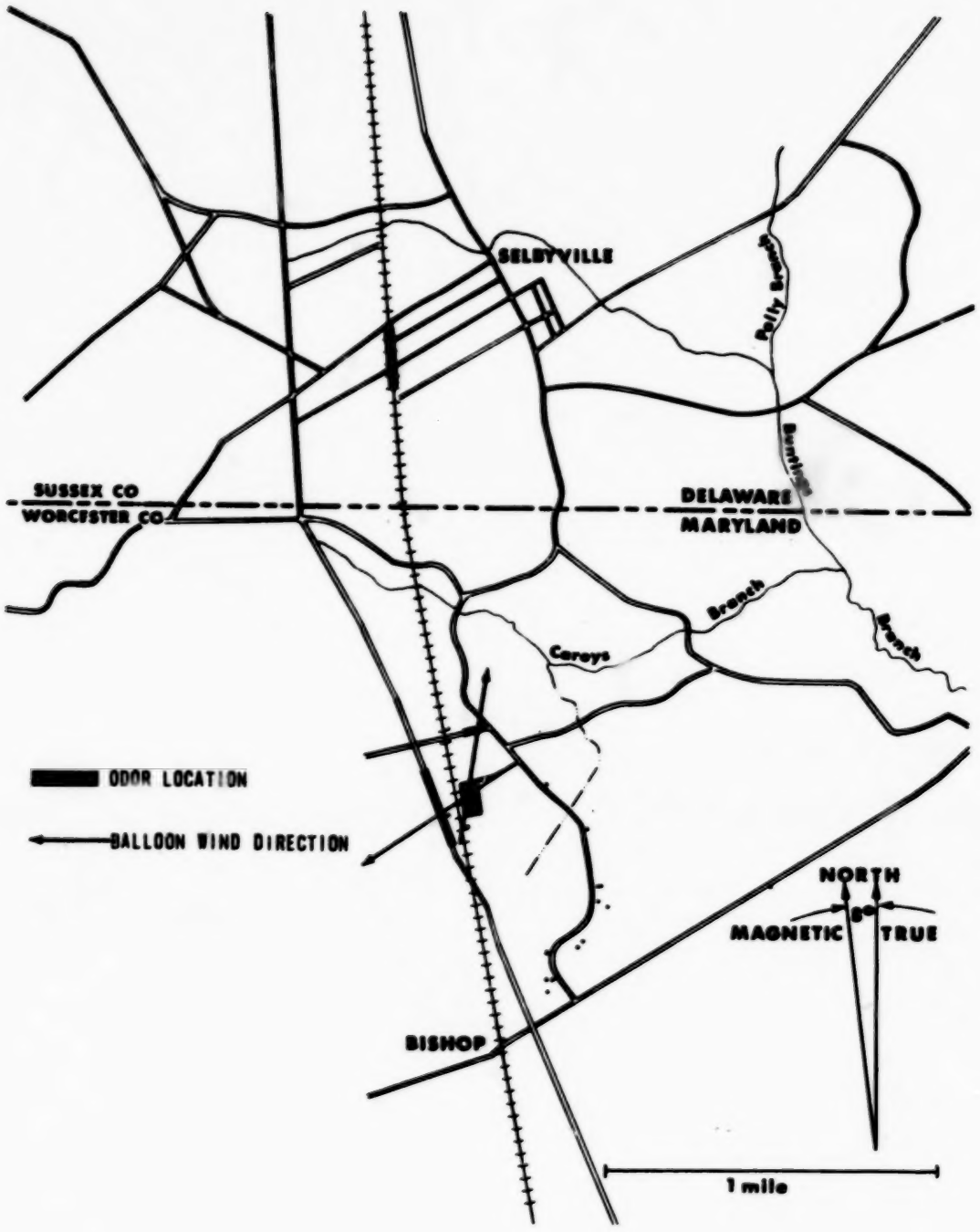


Figure 12. Source location by triangulation with data from Patrols No. 15 and 18.

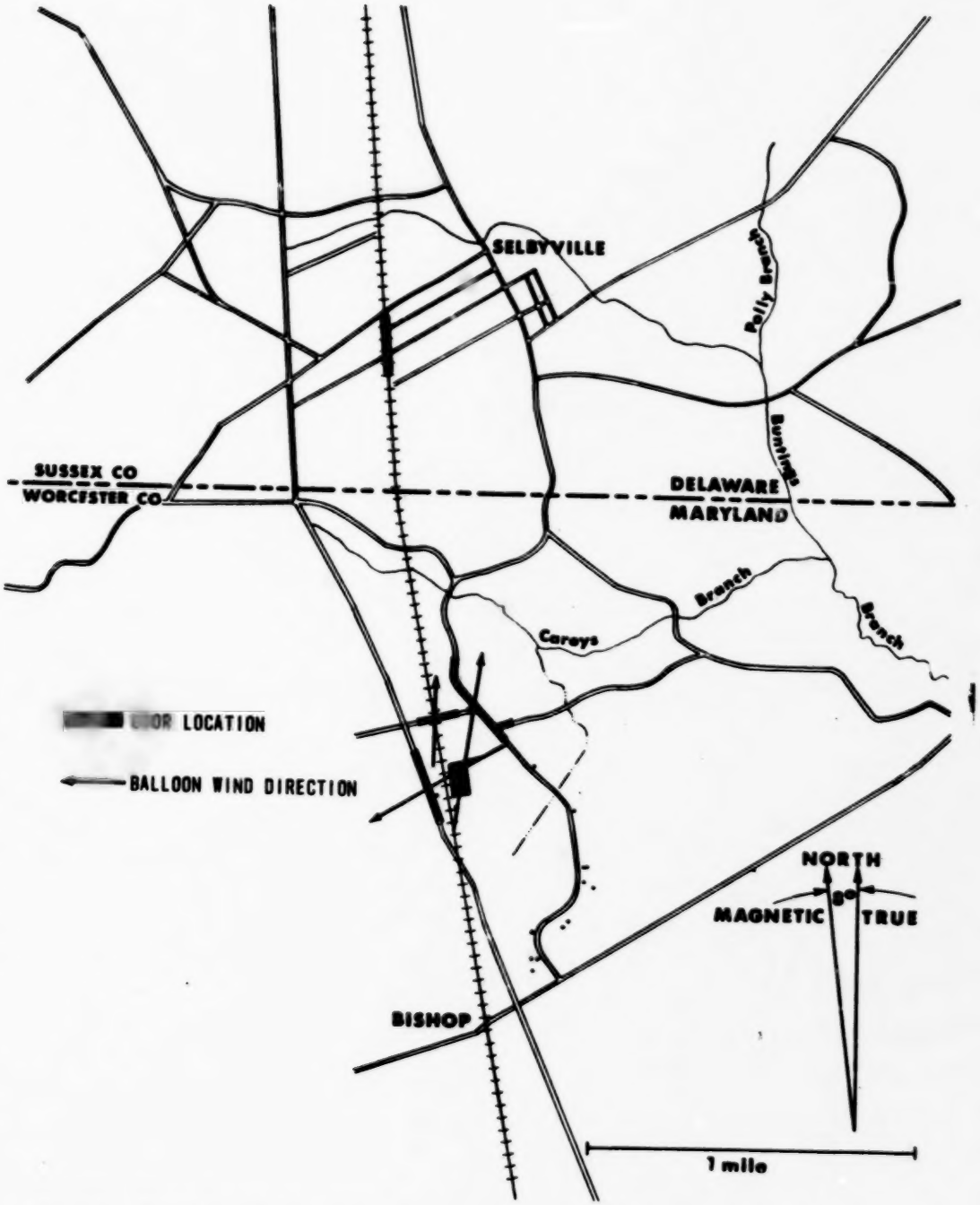


Figure 13. Source location by triangulation with data from Patrols No. 16, 17, and 19.

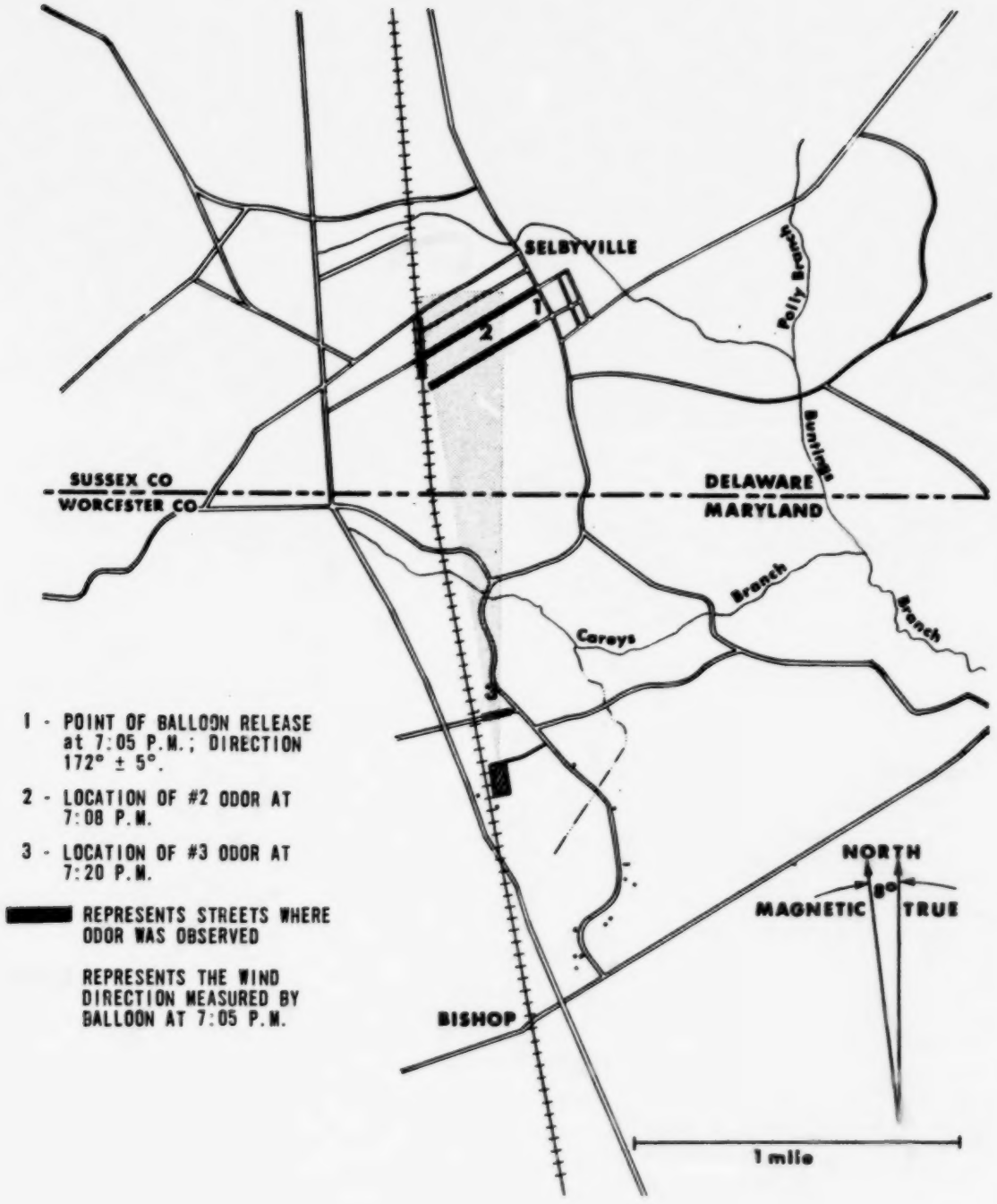


Figure 14. Patrol No. 1, 5.45 to 7:30 pm, August 18, 1965 Observer: Huey

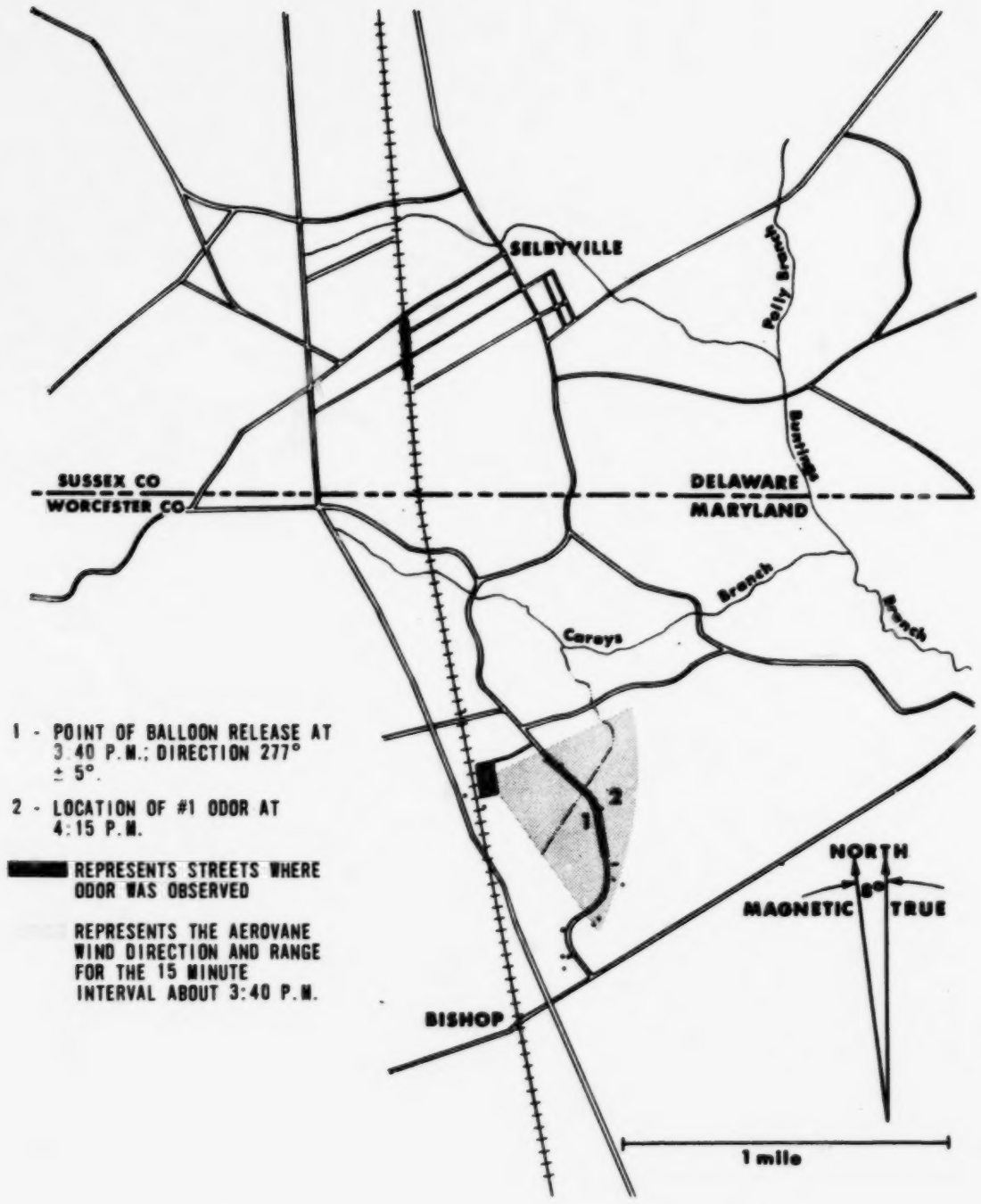


Figure 15. Patrol No. 2, 2.00 to 4:00 pm, August 19, 1965 - Observers: Huey and White

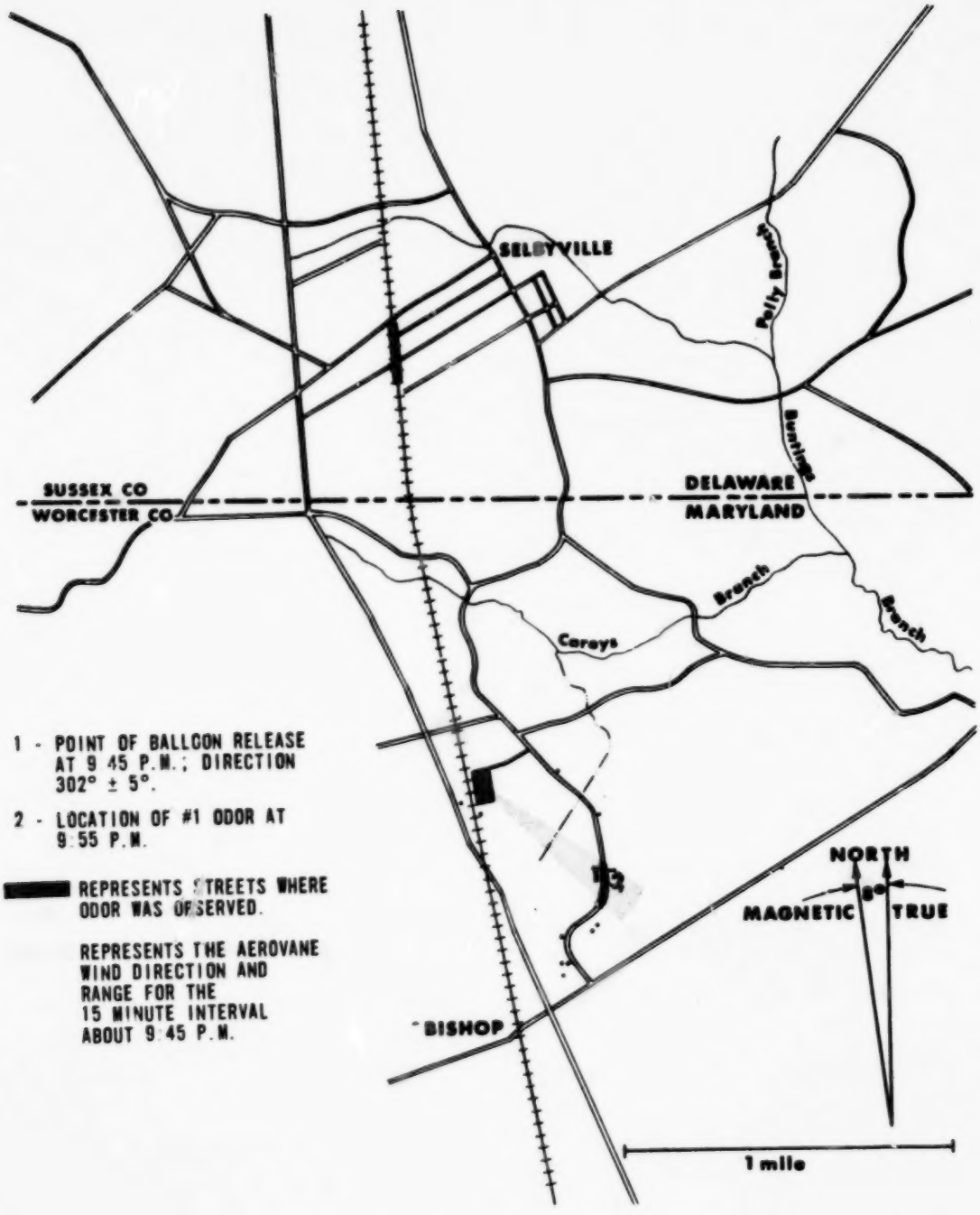


Figure 16. Patrol No. 3, 9:15 to 10 30 pm, August 19, 1965 - Observers Huey and White

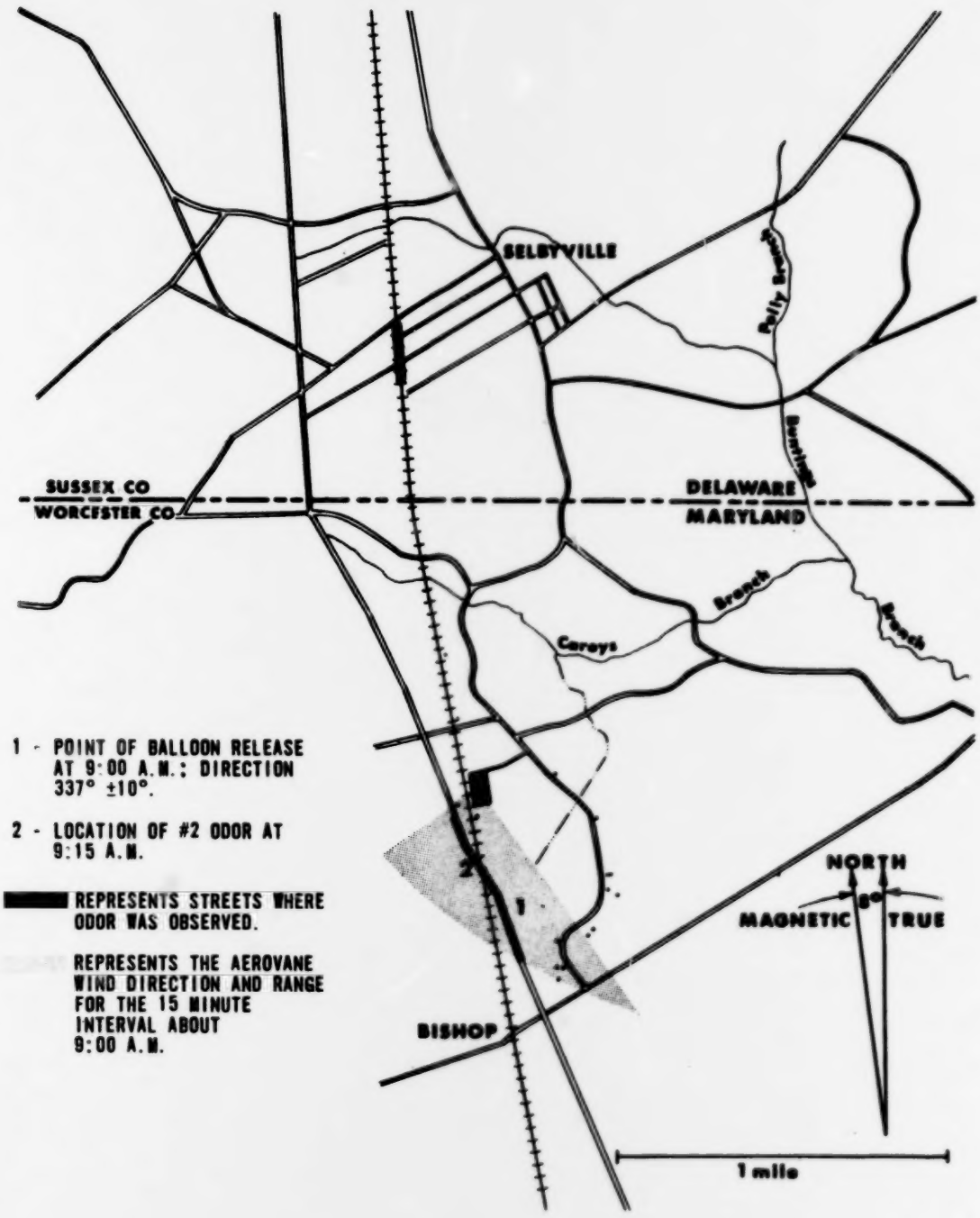


Figure 17. Patrol No. 4, 7:30 to 8:45 am, August 20, 1985 - Observers: Huey and White

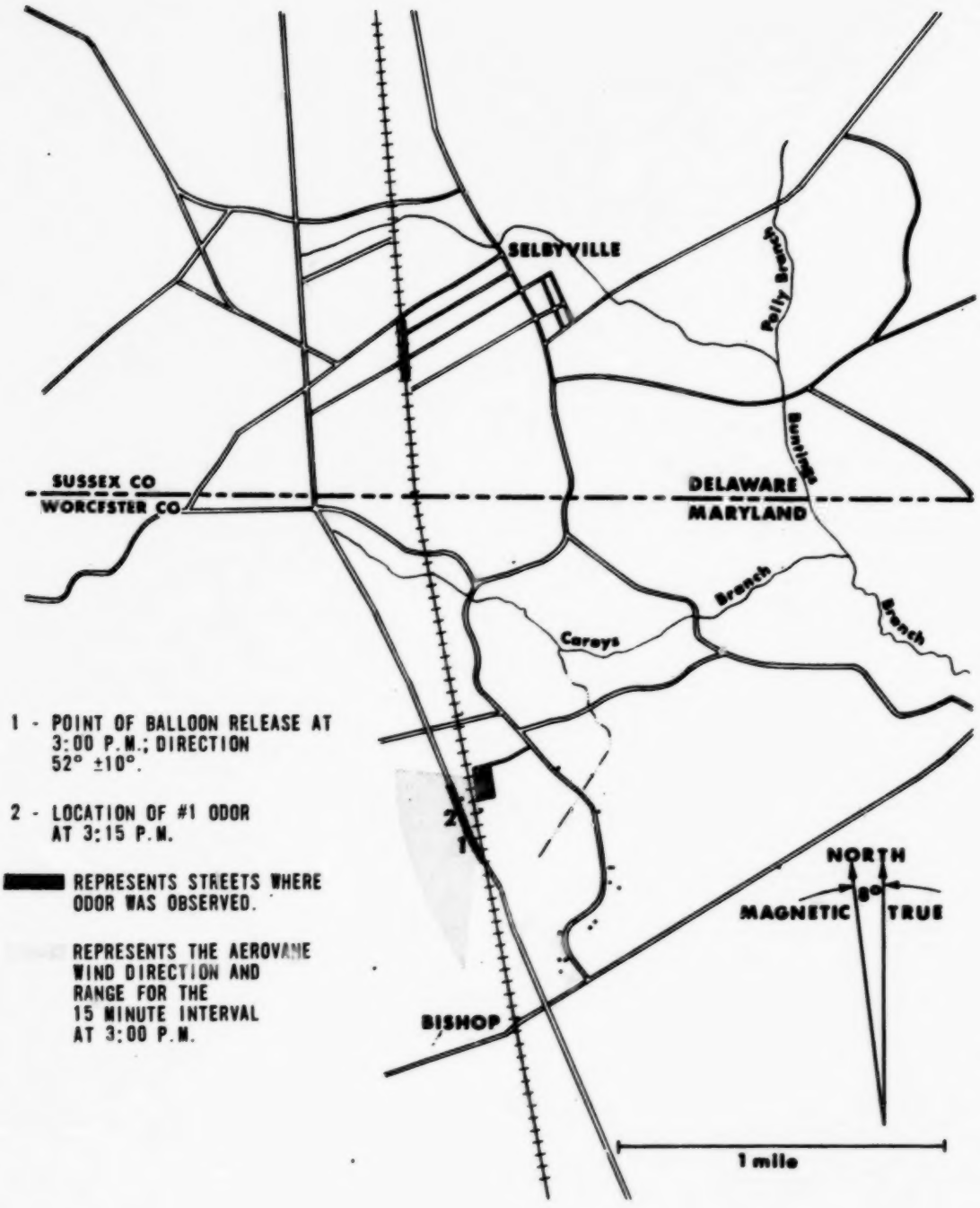


Figure 18. Patrol No. 5, 2.45 to 4.15 pm, August 20, 1985 - Observers: Huey and White

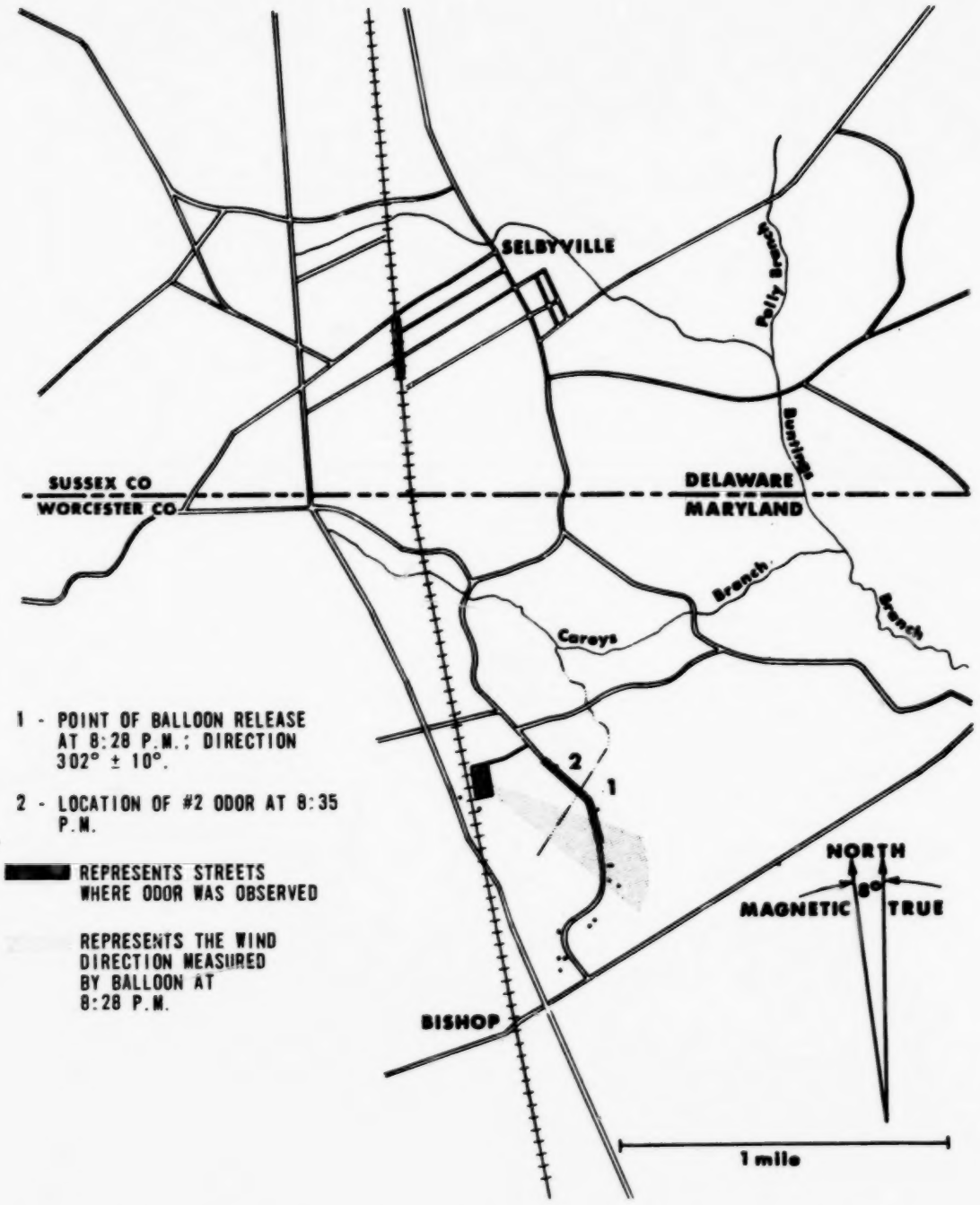


Figure 19. Patrol No. 6, 8:15 to 9:15 pm, August 20, 1965 - Observers: Huey and White

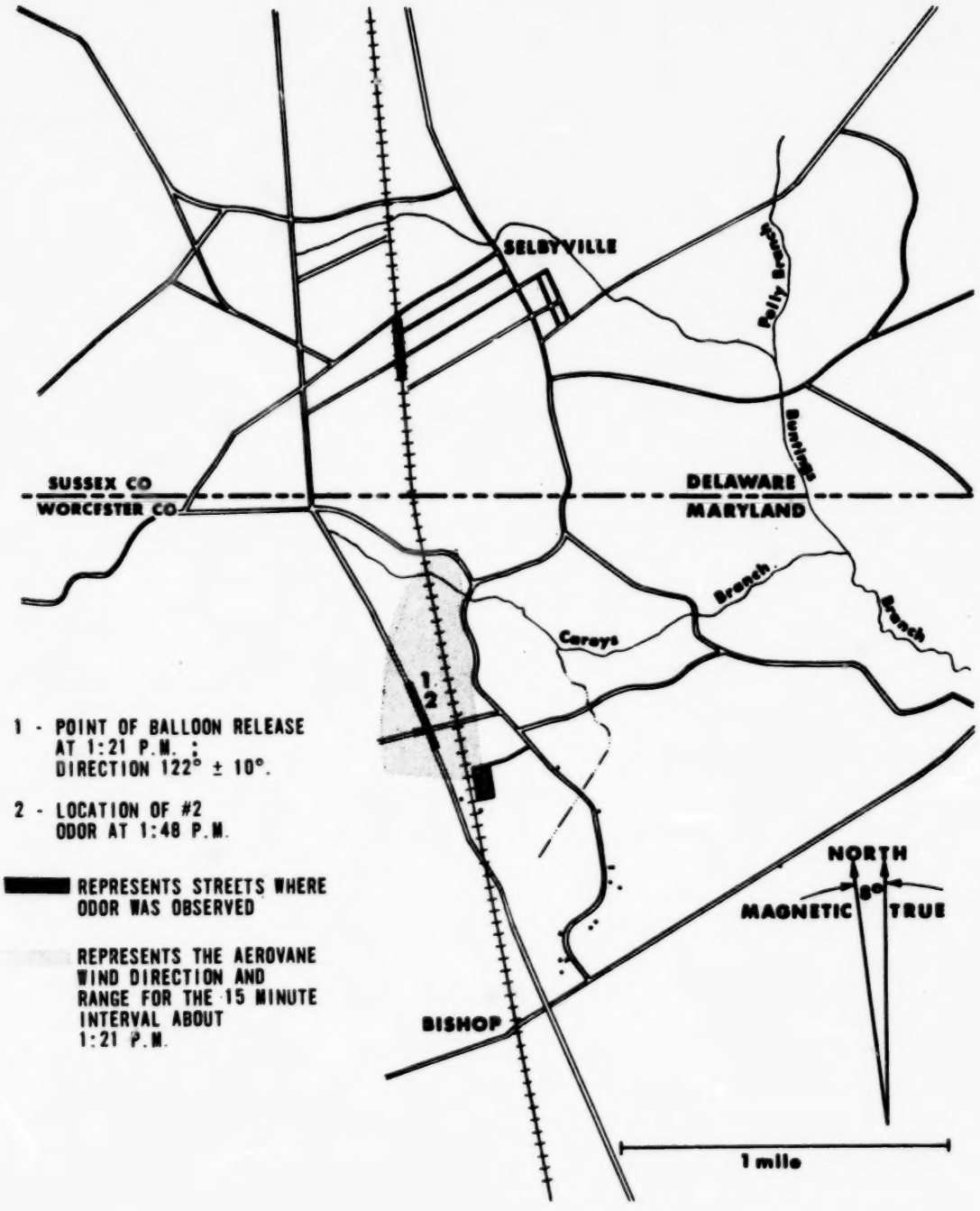


Figure 20. Patrol No. 7, 1:00 to 3:00 pm, August 21, 1965 - Observers: Huey and White

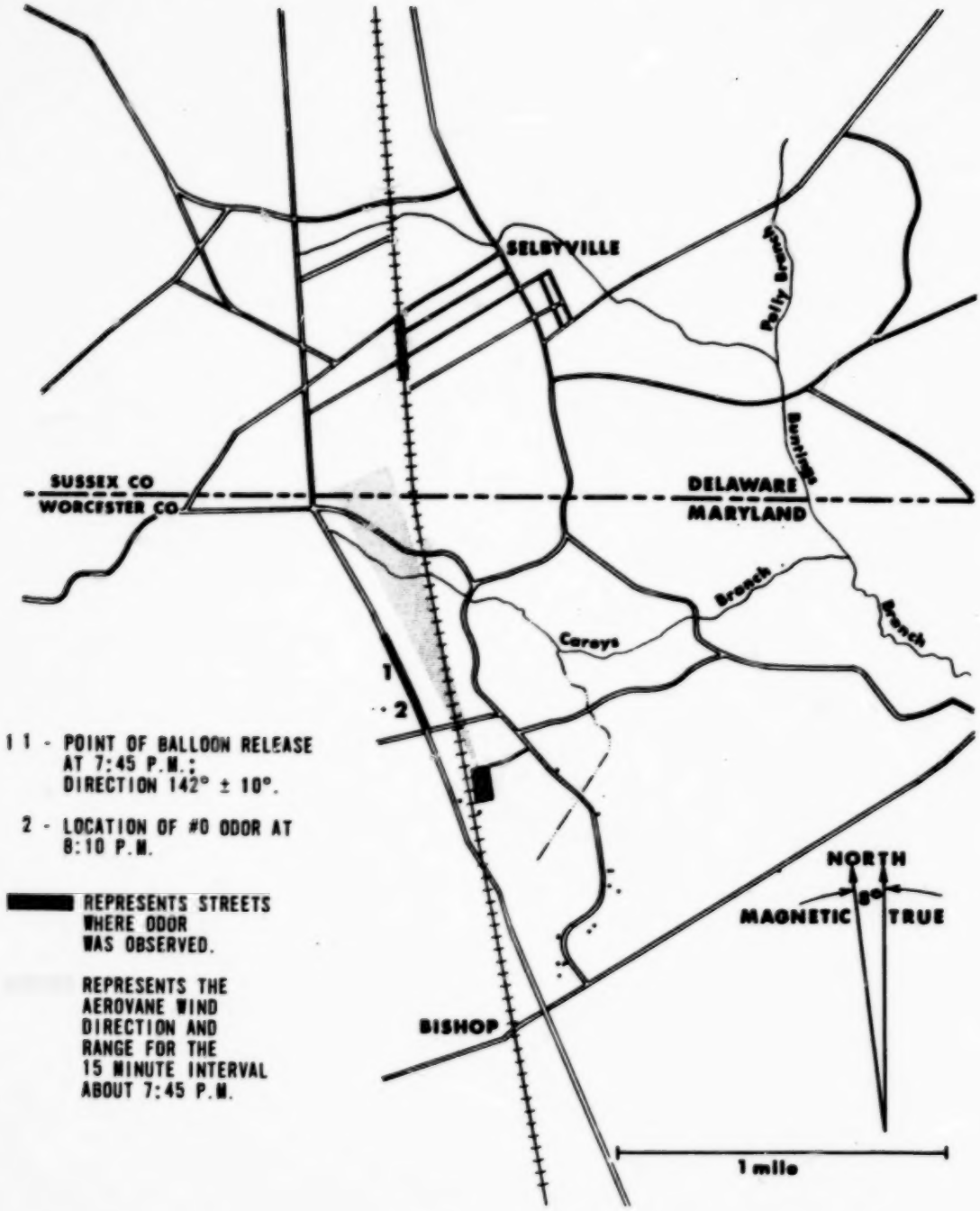


Figure 21. Patrol No. 8, 7:30 to 8:30 pm, August 21, 1965 - Observers: Huey and White

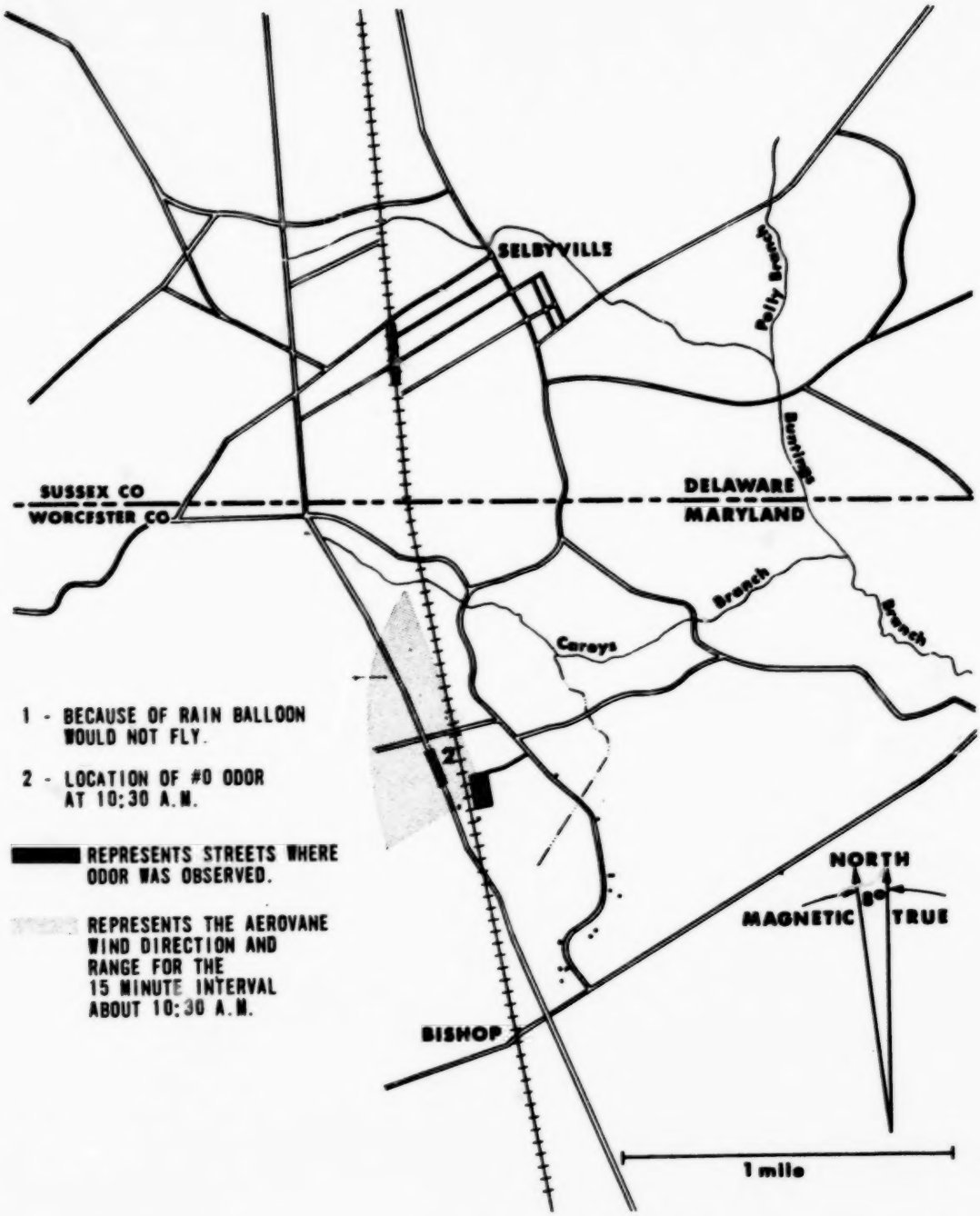


Figure 22. Patrol No. 9, 10:00 to 11:00 am, August 22, 1965 - Observer: Huey

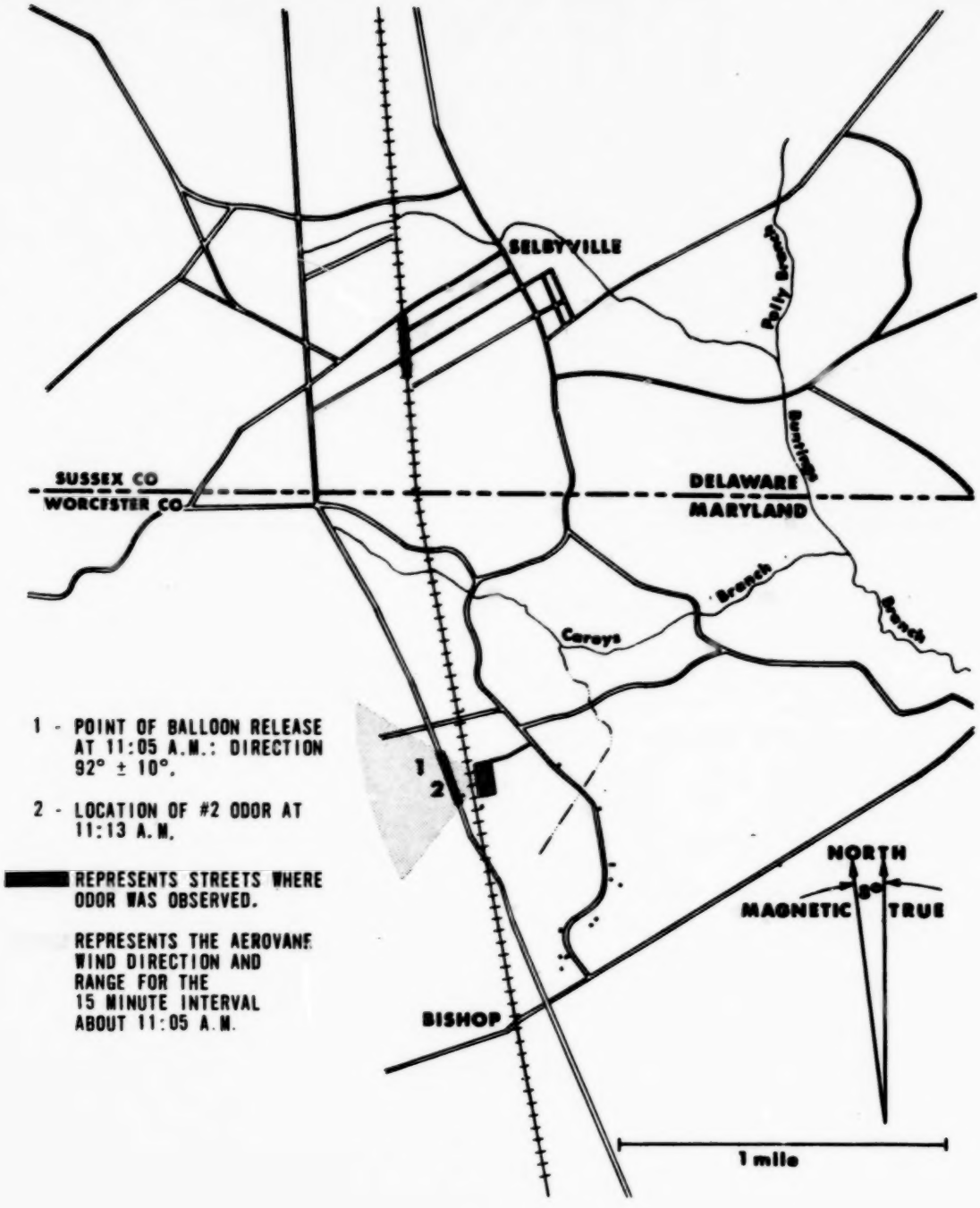


Figure 23. Patrol No 12. 10:45 to 12:01 pm, August 23, 1965 - Observer: Huey

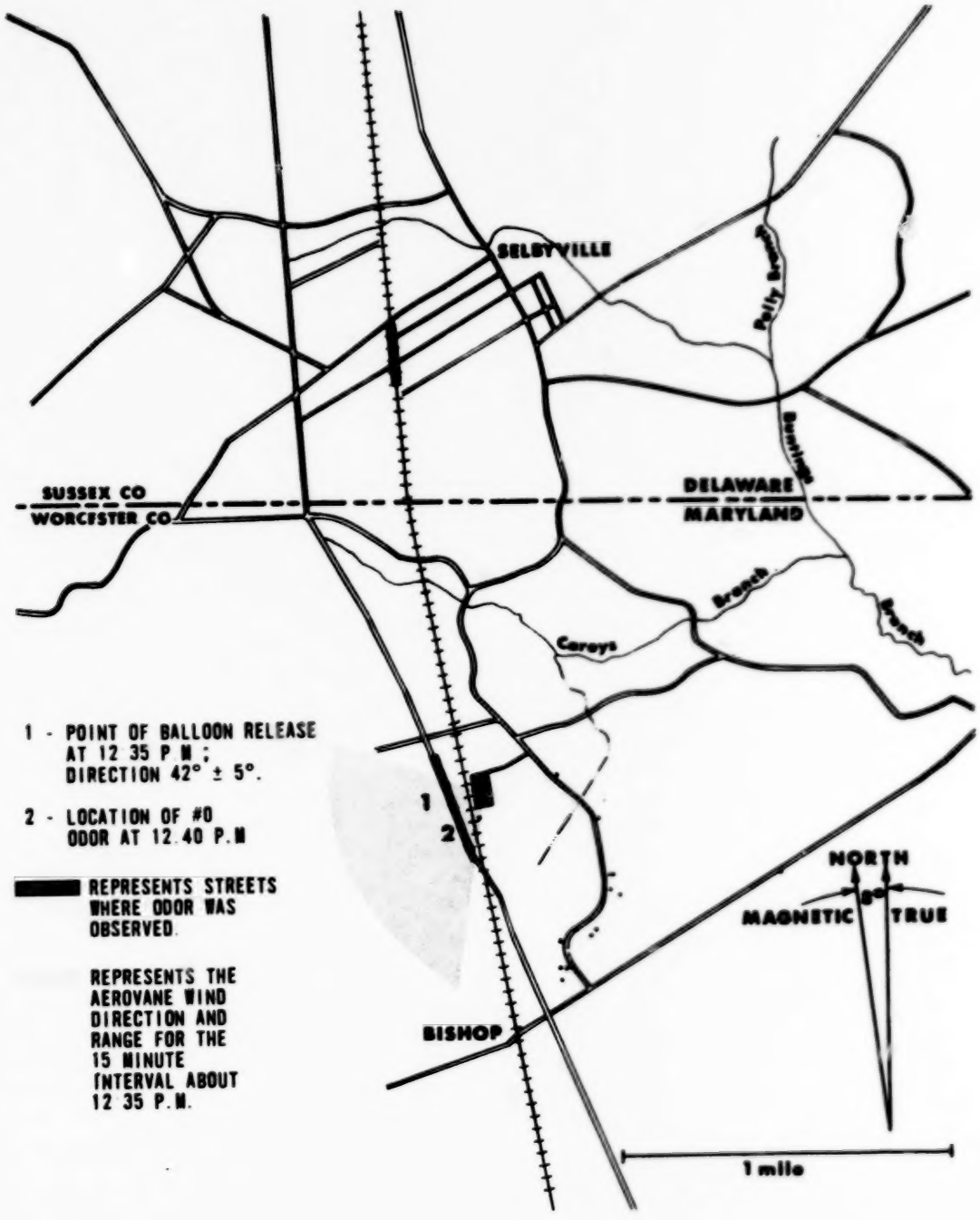


Figure 24. Patrol No. 13, 12 15 to 1.15 pm, August 23, 1985 - Observer: White

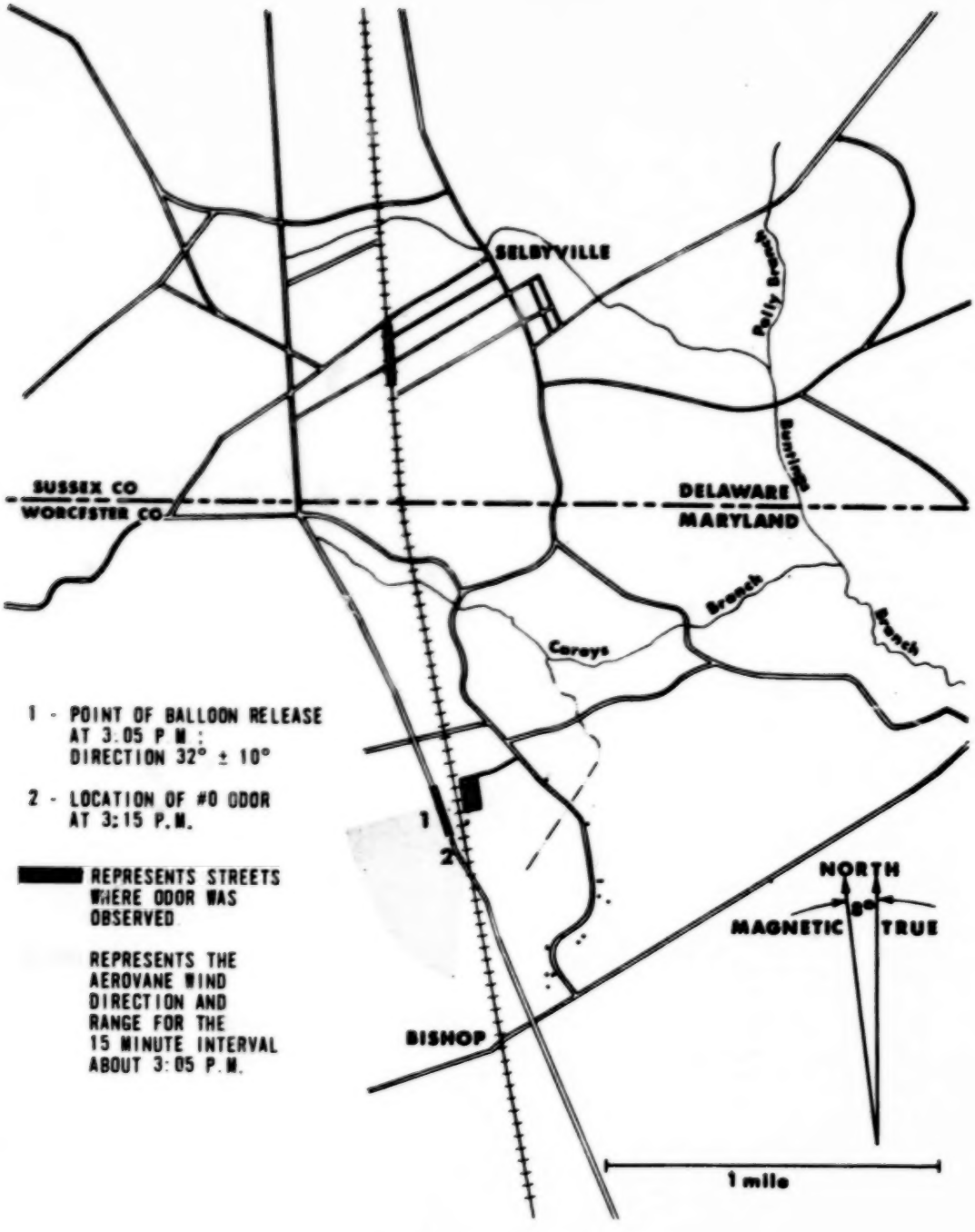


Figure 25. Patrol No. 14, 2:30 to 3:30 pm, August 23, 1965 - Observer Huey

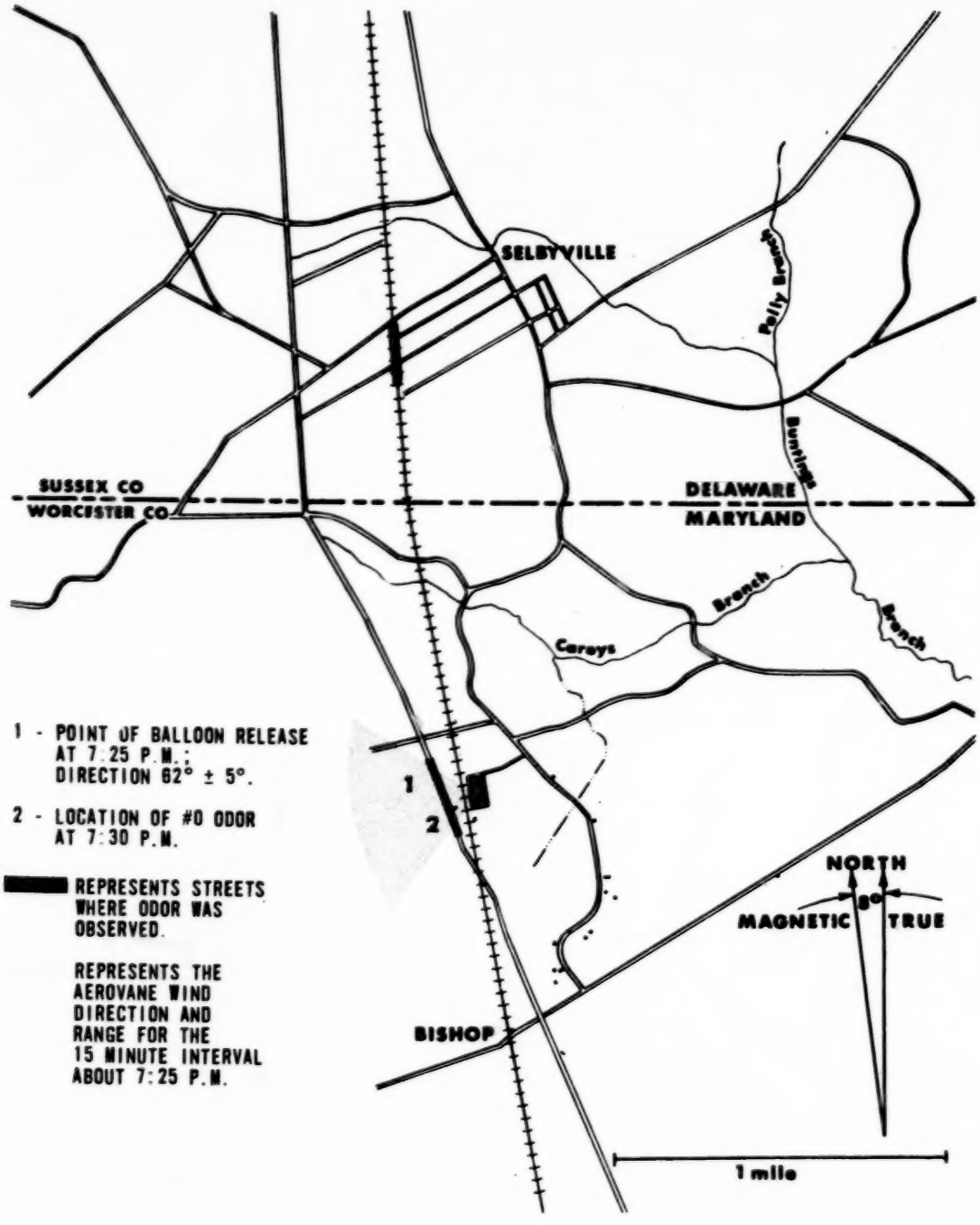


Figure 26. Patrol No. 15, 7:15 to 7:45 pm, August 23, 1965 - Observer White

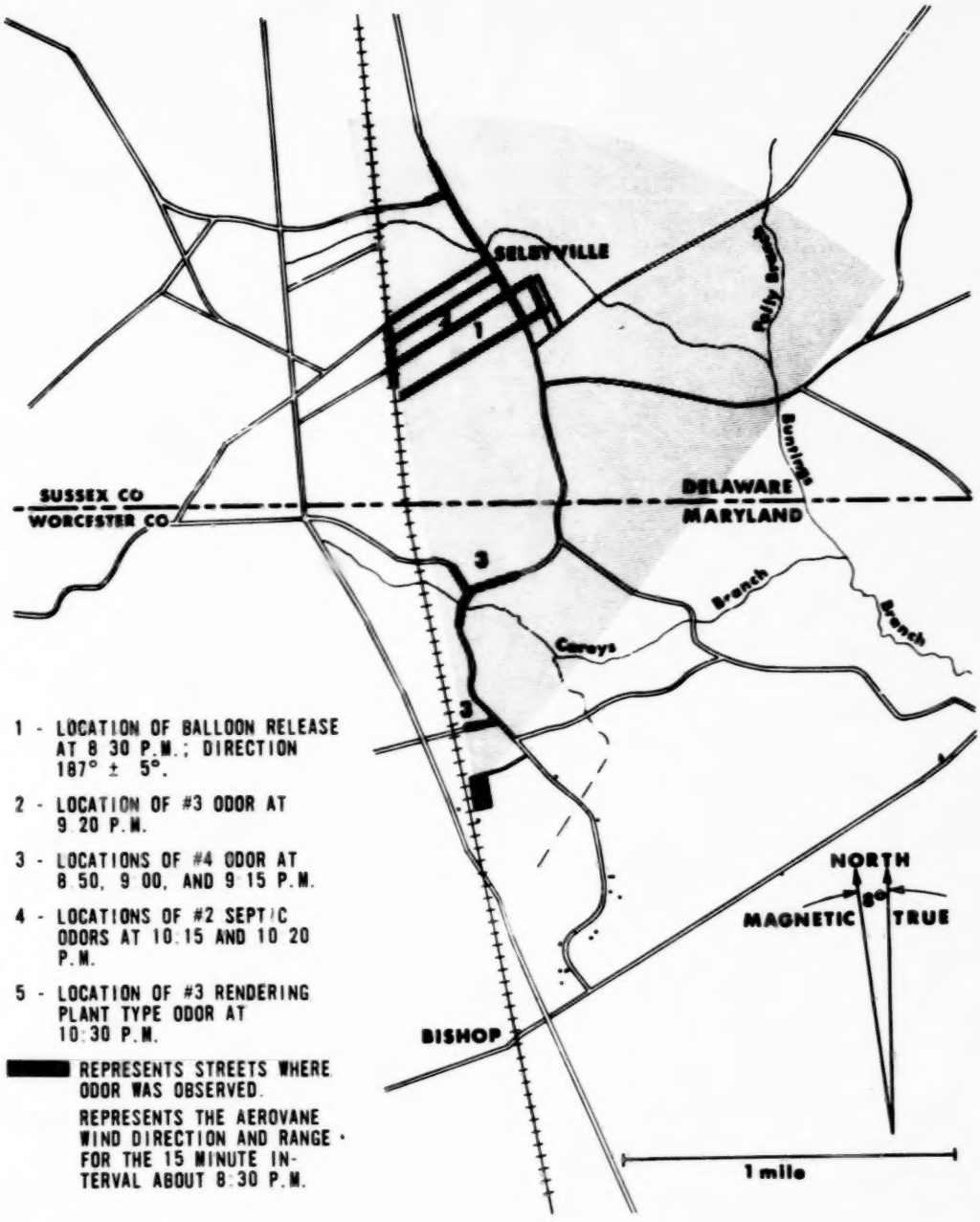

SELBYVILLE
Dolly Branch
Bunting
SUSSEX CO
WORCESTER CO
DELAWARE
MARYLAND
Branch
Branch
Careys
1 - LOCATION OF BALLOON RELEASE AT 8 30 P.M.; DIRECTION 187° ± 5°.
2 - LOCATION OF #3 ODOR AT 9 20 P.M.
3 - LOCATIONS OF #4 ODOR AT 8 50, 9 00, AND 9 15 P.M.
4 - LOCATIONS OF #2 SEPTIC ODORS AT 10 15 AND 10 20 P.M.
5 - LOCATION OF #3 RENDERING PLANT TYPE ODOR AT 10 30 P.M.
REPRESENTS STREETS WHERE ODOR WAS OBSERVED.
REPRESENTS THE AEROVANE WIND DIRECTION AND RANGE FOR THE 15 MINUTE INTERVAL ABOUT 8 30 P.M.
NORTH
MAGNETIC
TRUE
BISHOP
1 mile

Figure 27. Patrol No. 16, 8:00 to 11:15 pm, September 9, 1965-Observer: Huey

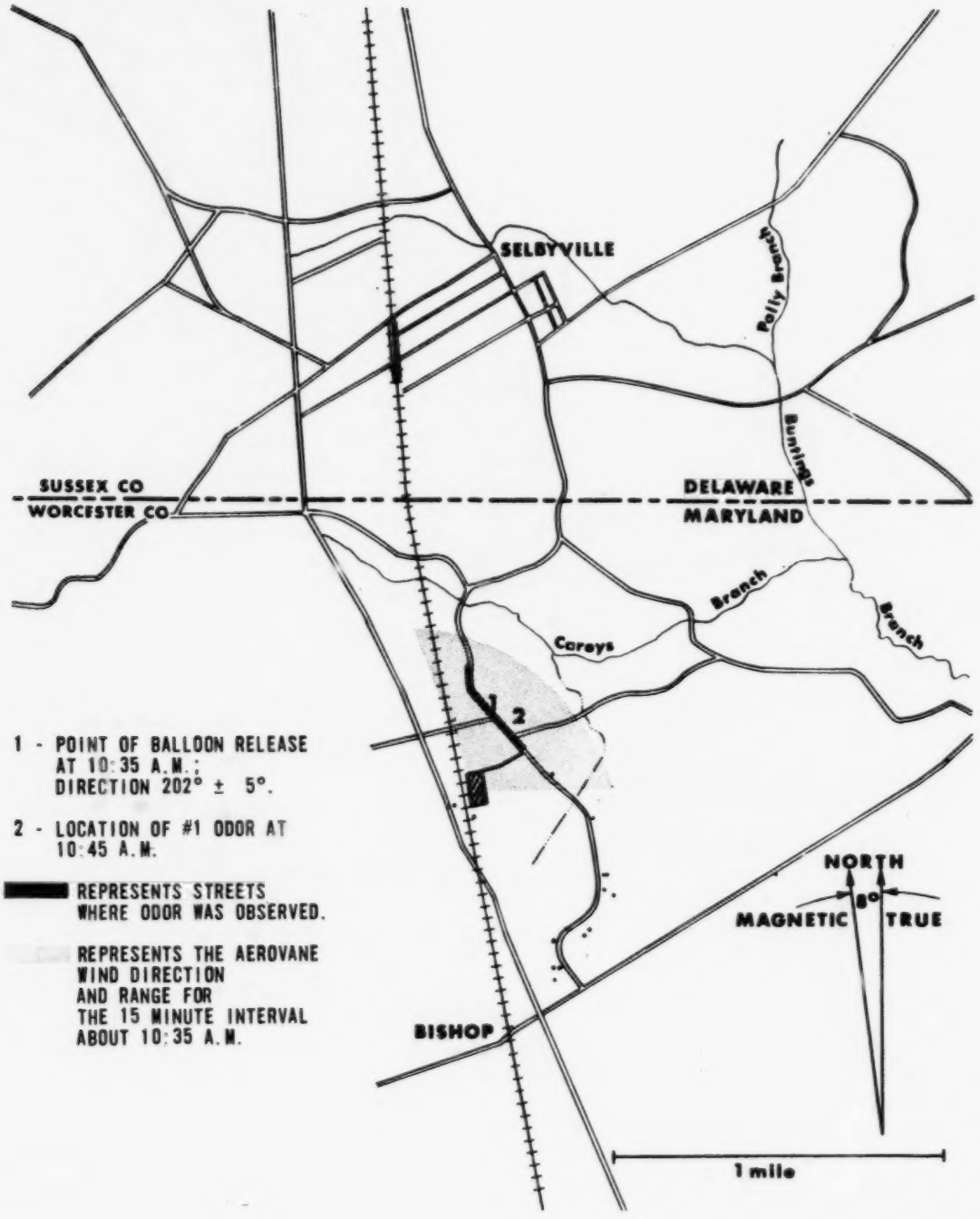


Figure 28. Patrol No. 17, 10:15 to 11:00 am, September 22, 1965 - Observer: White

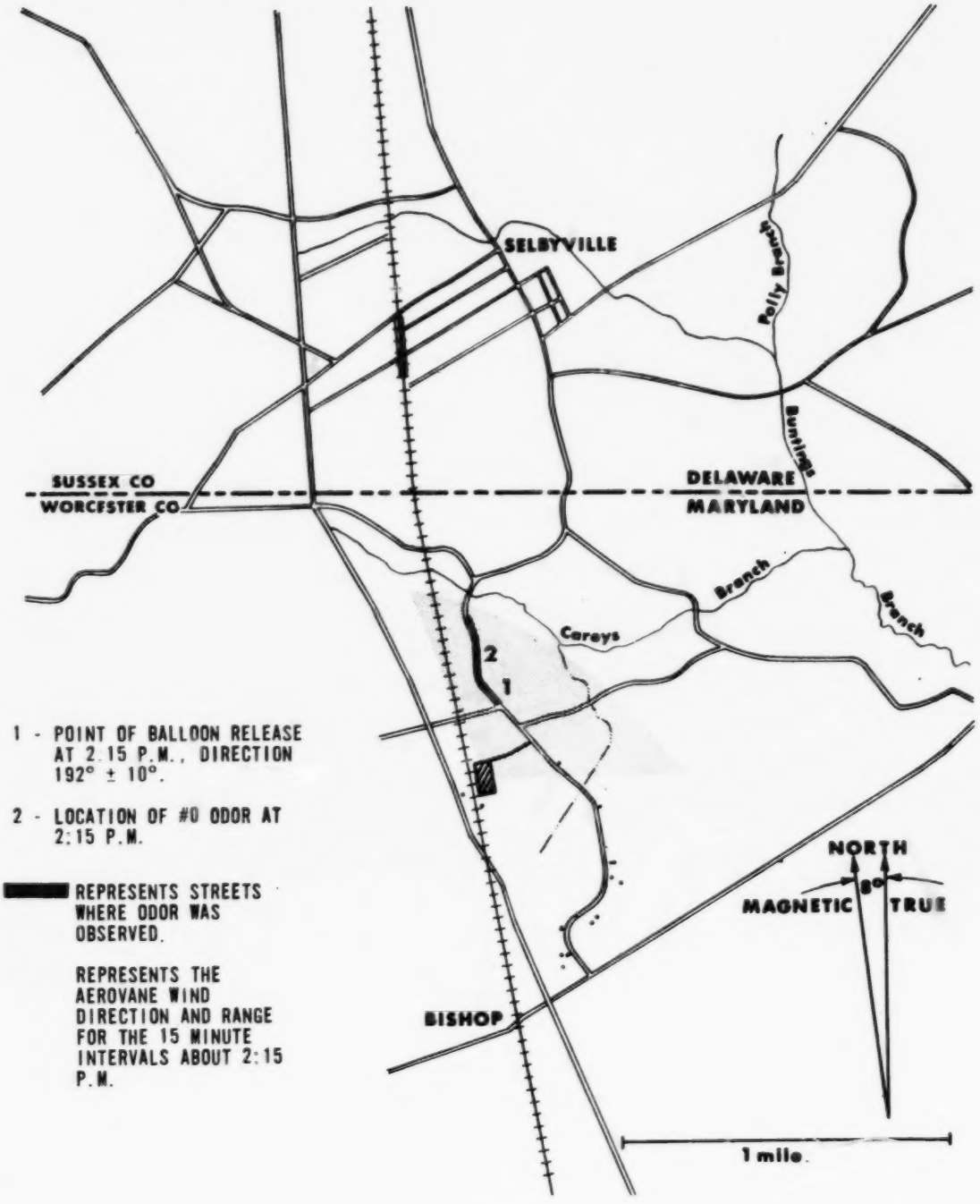


Figure 29. Patrol No. 18, 2:00 to 2:30 pm, September 22, 1965 - Observer: White

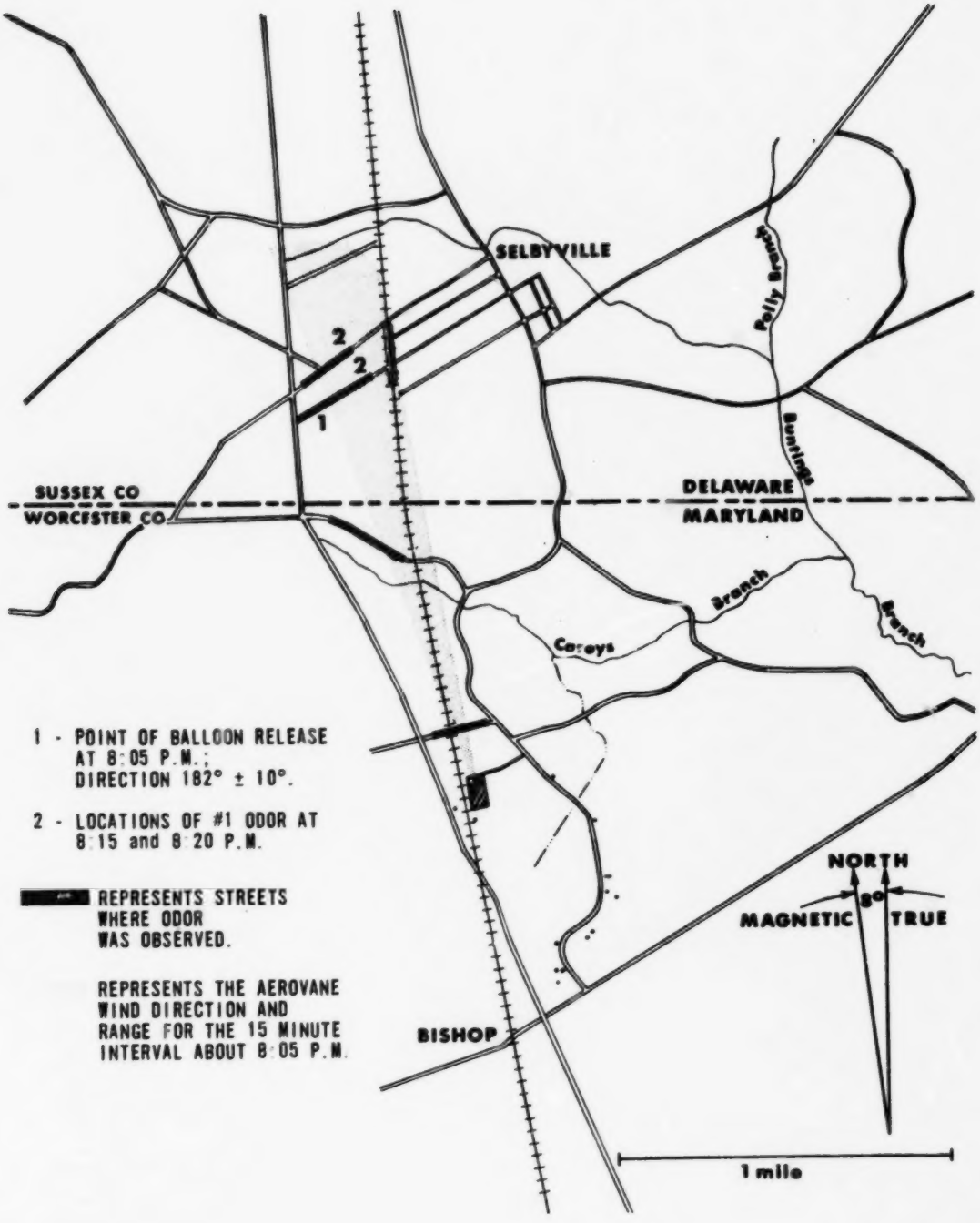


Figure 30. Patrol No. 19, 8:00 to 8:45 pm, September 22, 1965 - Observer: White

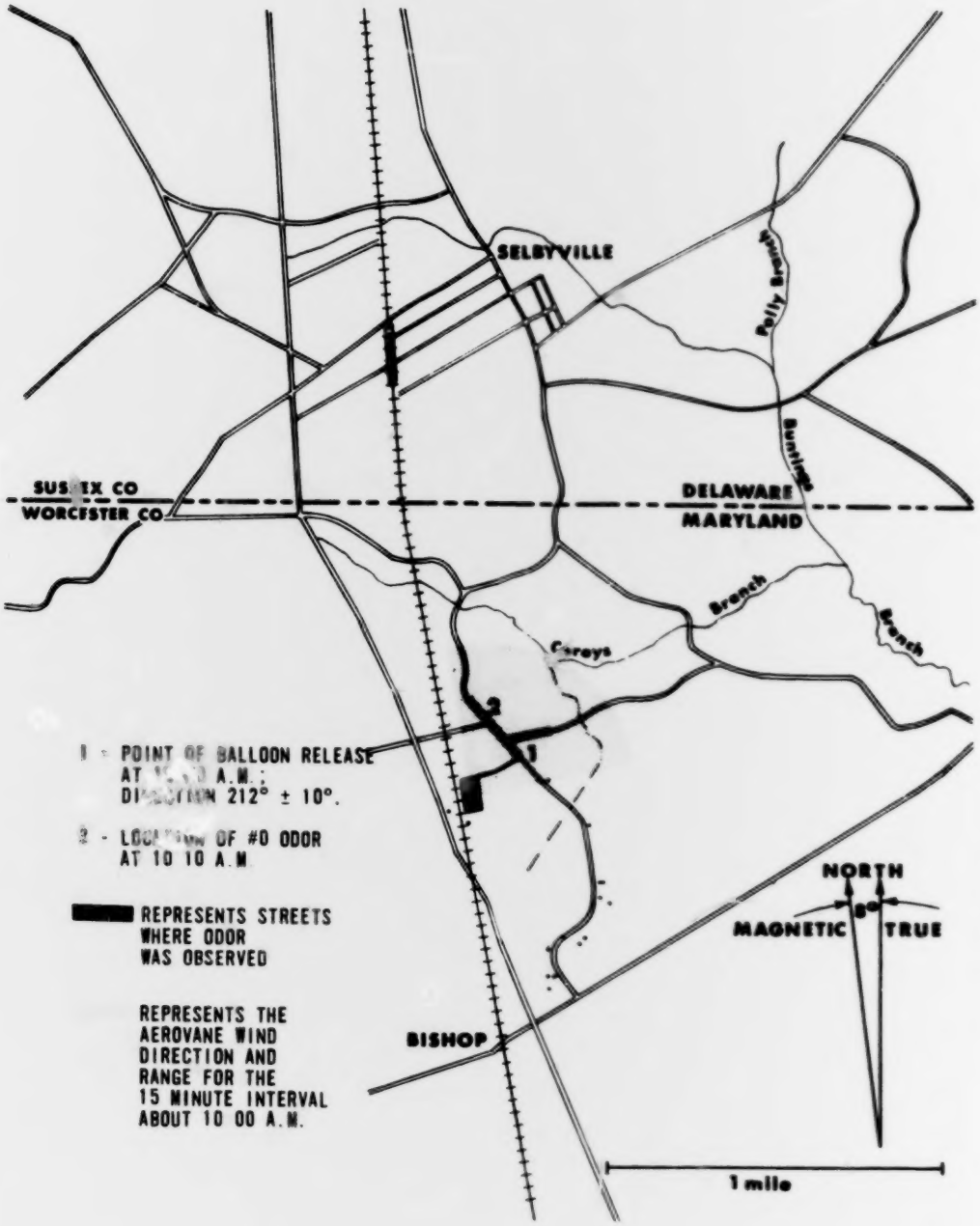


Figure 31. Patrol No. 20, 9 45 to 10 15 am, September 23, 1965 - Observer White